

Aviation Week & Space Technology

75 Cents

A McGraw-Hill Publication

April 29, 1963

PILOT REPORT:

**Bell 204B
Turbine-Powered
Helicopter**

Lockheed Rigid-Rotor XH-51As



60 CPS REAR EVENT

Honeywell test instrumentation records structural soundness of missiles

System records 112 test parameters simultaneously

Wyle Laboratory, at its Norco, California, facility, tests the structural soundness of Minuteman, Polaris, and Skybolt missile stages under transportation conditions with a battery of four multichannel Model 1012 Visconder oscillographs. The total Wyle-Honeywell system at the Norco Wyle test site includes eight 1012 Visconders, 64 Acculata III amplifiers, and a 14 channel FM tape system.

The Wyle test site uses Wyle hydraulic systems of about 100,000 fpm pounds, mounted on million pound concrete reaction blocks—the only installation of its magnitude in the industry. The hydraulic system reduces vibration into the ranges comparable to those encountered during transportation prior to launching.

The specimen record shows data recorded from accelerometers on the third stage of a missile at the locations marked on the record.

The fidelity, contrast, and easy readability of all Honeywell Visconder records is vividly shown in this record. When times are excessive and of the complexity or profile, the trace operator intervention, occurring at regular intervals along the time base of the record, make it easy to identify the individual traces.

For details about Honeywell Signal-Conditioning equipment, the Model 1012, and other Visconder oscillographs, and the LAR 7400 FM Tape Sub-system write Minnesota-Honeywell, Denver Division, 4500 E. Dry Creek Road, P.O. Box 5775, Denver 10, Colorado. Telephone DDD Area Code 303-794-4311.

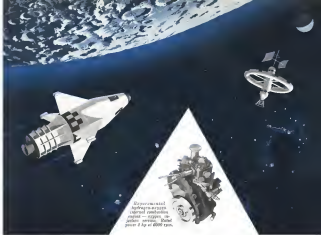


The Honeywell LAR 7400 FM tape system stores 14 channels of data.

A battery of multichannel Model 1012 Visconders directly records 112 parameters of information.

DATA HANDLING SYSTEMS

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- In space vehicles to drive an alternator and/or hydraulic pump, for equipment and personnel loading, for attitude control—can provide free drinking water as a by-product of burning hydrogen and oxygen.
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LIGHT WORKY. Low specific propellant consumption (0.75 to 1.0 lbs. per hp-hr.) in conjunction with low system fixed weight is offered by internal combustion engines currently being developed—a lighter system than any other for certain space missions.

BROAD CHOICE OF FUELS. A variety of fuels—cryogenics (liquid, supercritical fluids and boil off vapor) or hydrocarbons—can be used.

TEST DATA AVAILABLE. For technical information and comparison of H₂O engines with other proposed systems ask for Technical Report—"Hydrogen Engines for Space Power." Write to Vickers Incorporated, P. O. Box 302, Troy, Michigan.

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- ...MPC to 100°C operating
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MILLIWATT INTERIOMETER:

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- Address cycles can lock, 12 cycles lock in 1000
- Error corrected by address of 1 to 10,240 free word. Free word 8000 supports 10,240 11 operations internal program
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- 100 cycles
- ...MPC to 100°C operating
- Read tested by DI/AN

"HISTORY" AND "ONE" (present, no error) comes close to matching DI/AN's history of reliability in magnetic logic equipment for space. Proof: The operating history of these devices (and their predecessor) approaches a million hours in over 30 different spacecraft programs with no known failure. The modules used have a billion hour history.

RELIABILITY: This, mind you, is a record of actual use of our clocks, timers, counters, miniature memories, etc. The record is supported by two life tests of modules, 100,000 hours, which have topped 2 1/2 million module hours over 9 years — no failures, and 1 1/2 million module hours over 9 years — no failures. These numbers are for complete logic elements — but compare them with numbers for single components!

THE KEY to this history and reliability: The unique architecture inherent in magnetic logic designs: low power, low

components, non-critical semiconductor parameters, resistance to radiation and to extreme temperatures. Plus, extraordinarily high, fully cabled circuit density. (Over 10,000 high logic power CTL's per cubic foot) 1000 CTL's make a small GP computer.

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AEROSPACE CALENDAR

- May 13-19/81 Annual Conference, American Society of Airport Engineers, Cobb County, Ga., South Club and Civic Ridge Hotel, Fort Lauderdale, Fla.
- May 14-15/81 Airport Technology and Maintenance Seminar, MAA/ASAE/SAE, Washington, D.C.
- May 16-17/81 Annual Aerospace Symposium, Institution Society of Aeronautics, Tech. Inc. Bldg., San Francisco, Calif.
- May 17-19/81 Electronic Components Conference, Institute of Electrical and Electronic Engineers, International Inc., Washington, D.C.
- May 17-19/81 Electronic Engineering Conference, American Society of Mechanical Engineers, Netherlands Hilton Hotel, Cincinnati.
- May 19-20/81 Meeting, National Aerospace Standards Committee of the American Industrial Ass., United Nations, New York, N.Y.
- May 20-21/81 Meeting, Society for Environmental Science, Hotel Benjamin Franklin, South West.
- May 21-22/81 Quarterly Regional Meeting, American of Land Transport Admin., Fort Worth, Tex.
- May 23-24/81 Conference on Single Crystal Lines, Philips Research Laboratory, Blue Bell, Pa. Co-sponsored: University of Pennsylvania, Princeton University, Office of Naval Research, Advanced Research Projects Agency.

(Continued on page 7)

AVIATION WEEK & Space Technology

April 29, 1982
Vol. 26, No. 17

Aviation Week & Space Technology is a unique publication that provides a comprehensive overview of the aerospace industry. It covers a wide range of topics, including aircraft development, space exploration, and defense technology. The publication is a must-read for anyone interested in the aerospace industry.

The publication is published by the Aerospace Industries Association of America, Inc. (AIAA). It is a quarterly publication that is distributed to members of the AIAA. The publication is also available for purchase by non-members.

The publication is a valuable resource for the aerospace industry. It provides a comprehensive overview of the industry and its latest developments. It is a must-read for anyone interested in the aerospace industry.

Subscription: Single copies \$5.00; 1 year \$15.00; 2 years \$28.00. Payment in advance. Please send no money back. Payment may be made by check, money order, or VISA or MasterCard. Please allow 4-6 weeks for delivery. Please send address changes with old address. Please allow 4-6 weeks for delivery.



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The information behind such decisions is, inevitably, complex. In values, in variables, in uncertainties. And each decision itself may affect world-wide or continental forces and events. In making operational decisions today's commanders and governmental leaders use systems which provide information processing assistance. Developing these huge man-machine systems is the work of scientists, engineers, and computer programmers at System Development Corporation. Their concern is system development, not hardware development. They consider the

interaction and effect of men, doctrine, tradition, training, of organizations, chain-of-command and chain of succession, of communications, battle orders, command posts, computers and displays. They work before such system analysis. It continues through system synthesis, computer interaction, system testing, system evaluation and then in adapting the system to the changing needs of its users. Through all they strive to optimize man-computer relationships and also carry on research into future systems. *Human Factors Journal*, *Operations Research Society*, *IEEE*,

Systems. *Selected Engineers and Computer Programmers* interested in joining this expanding field are invited to write Dr. H. A. Ford, SDC, 2432 California Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica, Washington, D.C., Arlington, Massachusetts, Fairman, New Jersey and Dayton, Ohio. "An equal opportunity employer."



Systems that help men make decisions and control resources control
System Development Corporation

Decision-Making: Direction of Forces—What, Where, When?



AEROSPACE CALENDAR

- (Classified on page 5)
- May 14-16—National American Electronics Conference, IEEE/ANNA, Dayton, Ohio
- May 15-16—Fourth Annual Symposium on High Speed Testing, Hotel Somerset, Bristol, Mass. Sponsor: Flair Tech. Equipment Corp.
- May 15-17—Connecticut General Flight Planes' Second National Symposium on Air Terminals, Hartford, Conn.
- May 20-22—Annual Management Conference on Marketing in the Defense Industry, American Marketing Assoc., Boston College Campus, Boston, Mass.
- May 20-22-17th Annual Conference and Exhibit, American Society for Quality Control, Sheraton Hotel, Chicago, Ill.
- May 20-22—National Symposium on Microwave Theory and Techniques, Institute of Electrical and Electronics Engineers, Missouri Hotel, State House, Cold.
- May 20-22—National Telecommunications, Hilton Hotel, Albuquerque, N.M.
- May 20-24—Reliability and Maintainability Training Course, Army Research Corp., Fort Wadsworth, Washington, D.C.
- May 22-24—Third European Spaceflight Symposium, Stuttgart, West Germany. Sponsored: British Interplanetary Society (BIS), Société Française d'Aéronautique (SFA), Deutsche Gesellschaft für Raumfahrt (DGR), and Raumfahrt V (DGRV).
- May 21-22-15th Biennial Exhibit, Naval Air Engineers Society, George Washington Hotel, Washington, D.C., New York, N.Y.
- May 21-23—Spring Joint Computer Conference, American Federation of Information Processing Societies, Colorado Springs, Colorado.
- May 21-23—Symposium: Characteristics of the Lunar Surface, Boston, Mass. Sponsor: Air Force Cambridge Research Laboratories, Arthur D. Little, Inc.
- May 21-24-21th Annual Meeting and Short Conference, Aviation/Space, Western Airlines, Adelphi Hotel, Dallas, Tex.
- May 22-23—Fourth National Conference on Protein Synthesis and Production, Institute of Electrical and Electronics Engineers, Continental Hotel, Cambridge, Mass.
- May 22-23-13th National Meeting, Operations Research Society of America, Sheraton Hotel, Cleveland, Ohio.
- May 22-23-17th Annual Progress Control Symposium, Ballantine Hotel, Atlantic City, N.J. Sponsor: U.S. Army Electronics Research and Development Laboratory.
- June 1-4—Third Annual Reliability Institute, University of Connecticut, Storrs, Conn.
- June 3-5—Symposium on Materials and Processes for Space Power and Power Production, Society of Aerospace Material and Process Engineers, Radisson-Executive Hotel, Philadelphia, Pa.
- June 1-11—COSPAR Fourth International Space Science Symposium and Sixth Planetary Magnetosphere Workshop.
- June 4-6—17th Annual Conference and Exhibition, Annual Energy Communications and Electronics Area, Sheraton Park Hotel, Washington, D.C.
- June 4-6—Fourth Annual Radar Symposium, (Classified on page 9)

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Hydrol Mark II is standard equipment on Boeing's 707-320B, Douglas DC-6F, Convair's 440, Boeing's 707-330C and the USAF F-4C

AEROSPACE CALENDAR

(Continued from page 7)

Institute of Research and Technology, University of Michigan, Ann Arbor

June 4-6-National Electronic Packaging and Production Conference, Coleman, New York, N.Y.

June 6-7-Symposium on the Exploration of Mars, Denver, Illinois, Illinois Institute of Technology, Chicago; American Astronautical Society, Cosponsored, American Astronautical Society, American Institute of Biological Sciences, AFMA, Rocky Mountain Section, NASA

June 7-8-14th National Maintenance & Operations Meeting, Reading, Aviation Services, Reading, Pa.

June 7-8-1965 French International Air Show, Le Bourget, Paris, France

June 11-14-Symposium on Plasma Space Science, The Goddard, University of Virginia, Washington, D.C., with the support of NASA and Goddard Space Flight Center

June 12-14-Short-Term and Final Meetings, American Institute of Aeronautics and Astronautics, California Institute of Technology, Pasadena

June 13-16-Civil Aviation New Aircraft and Development Clinic, Ohio State University, Columbus, Ohio (conducted by the Office of Naval Research)

June 17-20-Symposium Meeting, American Institute of Aeronautics and Astronautics (AIAA), Hotel Ambassador, Los Angeles

June 17-20-Symposium Meeting, Institute of Electrical and Electronics Engineers, Toronto, Canada

June 18-19-41st Meeting, American Institute of Aeronautics and Astronautics, Chicago, Illinois

June 19-21-1965th Joint Aerospace Control Conference, University of Minnesota, Minneapolis, Minn., Sponsored, American Institute of Chemical Engineers, Institute of Electrical and Electronic Engineers, American Society of Mechanical Engineers, Instrument Society of America

June 20-25-1965 Annual Symposium on Computers and Data Processing, University of Illinois, Urbana, Illinois, University of Illinois, Urbana, Illinois

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EDITORIAL

Apollo and Its Critics

Like all great pioneering ventures, the Apollo manned lunar landing program is the target of a continual barrage of censure. The anti-Apollo chorus usually reaches a crescendo in the spring, when the National Aeronautics and Space Administration budgets its fairly rapid congressional decrease, and dwindles to a barely audible paragon after every successful U.S. and Russian manned space flight.

This year the critics' chorus is louder than ever and studded with many familiar faces ranging from ex-president Eisenhower, who still wishes the space age would dry up and blow away, to an earnest wing of the scientific community which appears to be disturbed by the fact that man-made types, such as engineers and pilots, have crept into the space program and are making their portion of it with rage and enthusiasm directed toward specific goals that some scientists regard as unseemly.

We doubt if any American would wish to return to those final dismal years of the Eisenhower Administration when the success of Soviet space triumphs subjected this nation to its worst international humiliation since British men-of-war stopped kidnapping American sailors on the high seas. Ex-president Eisenhower's cynical failure to understand that the space age had dawned and his Administration's lassitude in the first post-Sputnik years certainly disqualifies him as a solid critic of the present national space program, even without his candid admission that he really knows nothing about space. We suspect that when the history of those times is finally written, one of the great differences between the Eisenhower and Kennedy administrations will prove to be the former's inability to understand and cope with the technological tide of the era over which it presided, and the perception and vigor with which President Kennedy grasped the last early in his regime by establishing the Apollo program as a top priority national goal and sticking with it despite the critics' chorus.

One of the most fallacious arguments advanced by the Eisenhower type critic is that we are wasting money by trying to push into space too fast, and what is really needed is a more lengthy and thus more economical pace. The history of the Eisenhower Administration is studded with examples of research and development programs that were operated on this discredited philosophy. They resulted only in huge expenditures that produced few significant results. Actually, a technical program that is not run at its fastest feasible pace is the worst wasteful of all. Apollo is now moving at very close to its optimum technical pace, perhaps a shade too slow due to fiscal limitations. A slowdown or stoppage, as advocated by some critics, would only raise the eventual price of the program and delay the achievement of an significant goal and technology.

Another charge, often repeated by critics who have no firsthand knowledge of NASA's manned space flight program—Mercury, Gemini and Apollo—is that Apollo's last pace necessarily will expose major launch as little ventures. There is always risk in exploration of the unknown. But anybody who has seen a runway knowledgely of the operational philosophy of NASA's Manned

Spacecraft Center and has seen it applied to Mercury knows that it is based on providing the maximum crew safety commensurate with mission fulfillment. The same engineers who are managing the Apollo program have a long background of managing high speed light exploration through the sound and thermal barrier with winged vehicles and later with Mercury capsules, and most of their pilots are still around to tell their stories. Because of this special devotion to safety and the tremendous responsibility for transporting a man instead of a black box, the reliability record of the Mercury capsules and boosters has been far superior to that of the unmanned space probes and satellites.

The scientific community has traditionally provided the most solid opposition to the manned space flight program (see p. 24), but there has been a steady rise of conversion from critics to supporters during the Mercury years. This has been helped by the fact that it has become obvious that NASA does not intend to neglect scientific exploration because of the Apollo priority. As the NASA program has unfolded with the years, it has become apparent that considerable scientific exploration by instrumented satellites and probes is a necessary prelude to extending the parameters of manned space flight. It is also evident that manned space flight itself will offer a greater opportunity for scientific exploration of the unknown than could ever be possible using only remotely controlled instruments and data transmission. In fact, the major steps beyond the Apollo program are aimed at establishing manned laboratories on the moon and large orbiting space stations to expand the frontiers of scientific exploration beyond their present limitations. While the first Apollo lunar voyage will probably be made by astronauts of means, it is certain that once manned feasibility is demonstrated, these spacecraft will be used to transport a wide variety of scientists to the moon and orbital laboratories.

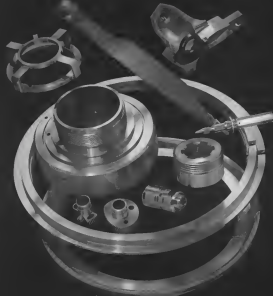
A successful program of manned space flight to the moon requires considerable advance scientific scouting by unmanned probes to produce data on which its optimum route can be calculated. The administration of the Ranger program to achieve its scientific objectives added no laurels to the advocates of pure science above all. They could better lend their talents to ensuring the success of the Surveyor lunar exploration program than continually crying foul from every town of detachment.

There are a great many valid, vital reasons why the nation must continue to press its exploration of space at the maximum feasible pace.

We intend to discuss them in the Apollo debate continues. But for the moment, there is no better summation of the purpose in this national effort than that stated by Brainerd Holmes, NASA's director of manned space flight and the chief engineer of the Apollo program, when he said in a recent speech:

"If we do not make these efforts we will not be first on the moon, we will not be first in space and one day soon we will not be the first on earth."

—Robert Holt



Challenge*

Each of these parts represents the design of a challenge. The titanium steel ligament at upper right—SFS ability to work in exotic metal. Precision rings in the center—SFS welding, approved by Navy, ASME, and Aircraft manufacturers. Halfway down from the top, on the right—a small part to remind you that SFS multiple operation machine tool (there are more than a thousand) have mastered the paradox of volume production to down tolerances...we call it "mass precision." What precision machined parts on your drawing board offer a challenge to SFS? We will gladly accept any challenge. STANDARD PRESSION STEEL CO., Precision Forner Division, Precision Machined Parts Sales, Jenkintown 3, Pa. (212-684-7300) • Santa Ana, Calif. (714-543-9311).

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WHO'S WHERE

In the Front Office

Joan T. Doshier, since vice president, Fairchild Systems Corp., Bloomington, Md., in charge of operations of the Avionics Division and Aircraft Systems Division. She formerly was vice president of the company.

Carl M. C. Weller, vice president-flight operations for National Airlines, elected a director of Automated Radio, Inc., Washington, D. C., and its subsidiary, American Radio Research Corp.

R. P. "Smiley" Cogges, vice president operations, Douglas Aircraft Co., Inc., Santa Monica, Calif. **Vin Tom Cadden**, vice president financial management and Charles W. Hutton, vice president marketing, Douglas Aircraft Co., Santa Monica, Calif.

Miss Cline, vice president, United Electronics Inc., Pasadena, Calif. In 1961, she became a manager of the company's United Electronics Div.

Robert W. Kovner, vice president sales, Vaid Division of Royal Industries Inc., Pasadena, Calif.

Dr. B. Clifford Spicer, a director, San Jose State Univ., Calif. Co. Cambridge Mass. Dr. Spicer is head of the department of Mechanical Engineering and Naval Architecture & Marine Engineering, and professor of Automatics & Automation at Massachusetts Institute of Technology.

Dorel E. Wynn, vice president, Sonoma Instruments Inc., Costa Mesa, Calif. in charge of the company's Electron Div.

Dorel J. Dorel and **E. D. Novack**, vice president, Allied International Corp., New York, N. Y.

Harry G. Kowalski, vice president/finance, Remington Corp., Detroit, Mich.

Richard W. Novack, president, General Automation Inc., Cincinnati, Ohio.

James H. France, vice president, Radiometrics Div., Fordham Electronics Corp., Long Island City, N. Y.

E. T. Farnham, executive vice president, Navco Instrument Corp., Gardena, Calif. N. Y., a subsidiary of Dynacore Corp. of America.

William E. Purdy, vice president and general manager, DeMott-Burns Corp., Pasadena, Calif.

John S. Doyle, vice president industrial relations, Republic Aviation Corp., Farmingdale, N. Y.

Honors and Elections

Jack E. Leonard, Eastern office manager for Hughes Tool Co.'s Aircraft Div., has been named chairman of the Vertical Lift Aircraft Council of the American Industries Association, Inc. **Y. W. Hwang**, secretary (NAF Feb. 13, p. 105). **Miss M. J. Gordon**, manager of contract engineering at Bosch Aircraft Corp., appointed chairman of the Technical Advisory Committee of AIAA's Military Aircraft Council.

J. M. Knechtel, vice president industrial relations for National Airlines, has been elected chairman of the Personnel Relations Conference of the Air Transport Association of America, succeeding Thomas D. Stuart, vice president industrial relations for Pacific Northwest Air Lines.

(Continued on page 111)

INDUSTRY OBSERVER

►Three to five separate Air Force statistics may be used in an automatic background measurement program contemplated by Air Force Space Systems Div. is follow completion of on-month studies now under way (NAF Dec. 24, p. 15). Statistics would carry infrared detector periods capable of measuring background thermal radiation in the near infrared, weakly emitted three-color wavelengths. They would gather accurate data to enable a multi-detection satellite to distinguish a rocket launching from common background radiation. Confusion in the Wain program was attributed in part to the absence of such data.

►Ryan Aeronautical has studied and is preparing to the military a light strike fighter with VTOL performance, based on its early experience in development of the X-15A-10 test vehicle. Fighter version would use a single General Electric J85 gas generator with three 500 lbs.

►Manufacturing the Apollo in-carry heat shield represents an major hurdle in the program. NASA's Space & Information Systems Div. is studying an shield material combination. Problems in bonding the layers so that the shield could survive long-term exposure to low temperatures without becoming brittle and later chipping during re-entry.

►New training version of the Bell rocket engine in the Lockheed Agena space vehicle will be increased to five and possibly 10 nozzles for the Gemini program. Multiple nozzles secondary propulsion system, consisting of four small efflux nozzles, also is being developed by Bell for the Agena target vehicles. Thrusters will burn nitrogen tetroxide and oxygen oxidized dinitrogen tetroxide from separate tanks for each engine. Thrust will be in excess of two loads—16 and 200 lb. There is a definite possibility that both the extended rocket capability and secondary efflux systems may be added to other Agena missions, such as Ranger, Mariner, Surveyor or Discoverer.

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►Air Force, looking for new ways to improve its low-level photo-reconnaissance capability, is asking industry to study the problem in a program sponsored by USAF's Aeronautical Systems Div. Study will cover data-link operations, altitudes from 200 to 3,000 ft., and speeds up to Mach 2.

►Army asked last week for competitive proposals for development of a flame halting system for the Bell OH-13 which will be used to fly target aircraft post ground troops armed with anti-aircraft weapons. Purpose of the test flights will be to determine damage which can be inflicted by anti-aircraft fire.

►Marquardt Corp. plans to construct a test facility near Magic Mountain, Calif., to conduct accelerated development tests of its liquid hydrogen-burning engine (NAF Nov. 6, 1961, p. 39). Tests will be conducted at the company's Field Research Laboratory at Sonoma, Calif. Marquardt program continues to be funded by the Air Force Aeronautical Systems Div.

►Nuclear radiation dose and dose rates over a range of altitudes and distances will be studied with the aid of a machine program to compute these quantities. Program will be supported by Air Force Special Weapons Center, Kirtland AFB, N. M. Industry proposals have been requested for submission today. Calculations will be made for all altitudes of ground over-pressure distances between 100 and 10,000 psi. Radiation from weapon prompt gamma rays, fast neutrons and known product gamma rays will be studied.

►Detailed need now for counter-emergency (COIN) aircraft—estimated at 90 for Marine Corps plus an undetermined number for the USAF Marine Air Program—has been seen for delay in testing requests for proposals. Target price of \$200,000 for the COIN aircraft could be attained if aircraft tests were produced.



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Washington Roundup

Controlled Fusion Race

Soviet Union but work closest to have taken an important step on the long road toward controlled thermonuclear fusion—the same type of advance claimed a week earlier by the University of California's Lawrence Livermore Laboratory, which is operated for the Atomic Energy Commission.

Russia said it had produced plasma with a density of 10 billion particles per cubic centimeter at a temperature of 40 million deg. for hundredths of a second. Lawrence Livermore had said it had produced a plasma with a density of about 100 million deuterium nuclei per cubic centimeter at 200 million deg. for one-half second.

Both experiments appear to indicate that the plasma instability found at moderate densities—and once considered an insuperable barrier—disappears at higher densities. Both countries pointed out that there is still much to be done before the extremely high densities and longer time periods necessary for significant control of the fusion process can be reached.

Secretary of Defense's office and the military services will meet May 15-17 at Navy's suburban base at Gordon, Conn., to explore ways of responding to higher-level program advice and considering the weapon procurements program the war. Secretary Robert S. McNamara and his advisers went at it alone. Industry participation will be limited to a few invited presentations.

Defense Views Complex

Even though Defense Dept. spends nearly 10% of the national income and employs 5.7 million people directly and influences millions more, Defense Secretary Robert McNamara is not concerned about what he referred to as "the so-called 'military-industrial complex'." McNamara told the American Society of Newspaper Editors that, "if anything, the potential dangers [of the complex] have been overestimated rather than understated in recent months." Just a month ago, however, Deputy Defense Secretary Russell G. Gilpatric was warning in public about influence of the "complex" in connection with the TFX case (AW Star 15, p. 25).

Industry reactions to the proposed defense contractor evaluation plan (AW Apr. 15, p. 32) will be presented in Pentagon officials May 5-6 by the Defense Industry Advisory Council. McNamara wants more scheduled to give their views late but work. Hearing more objections, the plan will be presented to Defense Secretary McNamara for final approval.

Rubel to Leave Defense

John Rubel will resign as assistant secretary of defense for research and engineering soon to return to industry. Speculation is strong that he will be succeeded by Eugene C. Feltus, deputy director for research and information systems in the same office. Rubel, who came to the Pentagon from Douglas Aircraft four years ago, has been a sharp critic of Air Force's space ambitions and of major overruns in USAF programs. He introduced the "program definition phase" in major development programs.

Proposed for an unmanned, 73-hr. flight of a Mercury capsule to test effects of microgravity and solar radiation in space support and mission segments of NASA. Its backers believe a manned MA-10 flight would demand two-thirds of the already overstretched life support system and would return no more significant data than would Gordon Cooper's forthcoming 34-hr. MA-9 flight. MA-10 would fly at about 140 mi., higher than any previous Mercury flight. Approval depends upon the success or failure of MA-9 (see p. 25).

'VTOL Blood Bath'

Two-day government-industry conference on vertical and short take-off-and-landing aircraft concepts, held at Kirtland AFB, N. M., last week in being called "The Abortive Blood Bath." Because of many companies with so many programs are fighting for such a narrow market. Defense Dept., National Aeronautics and Space Administration and Federal Aviation Agency participated. Panels covered utility transports, fighter-attack reconnaissance aircraft, special purpose aircraft and civil aircraft.

SST Bogus Snafu

Federal Aviation Administrator N. E. Hulsley, who has been trying to fast down the works on off-road market that a concept-type of corporation might be involved in developing the important transport, finally said last week that the idea probably must face "a BOCISAT." That's a Bunch of Guys Sitting Around Talking.

—Washington Staff



Balzac VTOL Undergoes Transitional Flight Tests

Downed Balzac, prototype of the M-2000 VTOL strike fighter, has been flown through eight transition flight tests since its first horizontal flight in 1980. Balzac, recently equipped with reusable gas (AW 35, p. 15), is shown here in horizontal flight with its lift fan component doors open. Balzac is powered by a single Rocketdyne Olympus and carries 80,000 lb of engines.

NASA, Scientists Divided on Space Goals

By Rodrick D. Hibben

Washington—Increasing conflict between NASA and the scientific community over what constitutes the important goals in the space program was brought to light last week during the 1980 annual meeting of the National Academy of Sciences.

Prof. Harold C. Urey, Nobel prize winner in chemistry of the University of California, laid out a case for a system in space research that he described as "very difficult" with the statement that only 1% of the scientific community could be needed to implement the program. He said the statement was made by James E. Webb, administrator of the U.S. space agency, during an evening at the National Academy of Sciences.

"I don't believe that there are enough of these scientists at NASA. I don't think NASA is attracting enough of these scientists," Urey said. He attacked this in the fact that the National Academy and Space Administration could not show the single-mindedness of purpose necessary to meet scientific needs, due to increasing outside pressure for development and therefore conflict in goals.

He contrasted the space program with the AEC Mission Program by saying that first-rate scientists had been selected in major aspects of the fusion reaction before the war and had reached within their efforts to accomplish those problems during the war. However, lack of information about the space program had left many capable scientists ques-

tioned where the emphasis was being made on what the goals were. Dr. Cohen S. Pincus, director of Princeton University, strongly argued that a national policy statement at the "highest" level be made, similar to the statement which suggested the Apollo program, so that "we should not undertake a national space program if we believe it ought not to be undertaken." In the search for extraterrestrial life, he said, needs of an untrained space probe observation would not accelerate the need for first-hand information.

He stressed the urgent need for a well-defined distribution of our scientific efforts in the U.S. military on an international prestige race. He concluded:

Isolation Tests

Washington—Isolation of research in Apollo and Gemini spacecraft budgets will follow a NASA University of Michigan experiment in which a subject spent 172 days in isolation confinement.

National Academies and Space Administration officials and the experiment in which William P. Brown spent five months in a 12 x 12-ft room was a first attempt to develop techniques to isolate isolation and performance tests in the spacecraft situation.

NASA and the following tests would be conducted at the University of Virginia and in NASA and industry facilities where workup and flight simulators are available.

Tests included the University of Maryland chamber on Nov. 17, 1982 and continued Apr. 17.

the isolation problem to be more noted for the Mars mission than for Apollo since even its generally admitted isolation of less than 100 days.

When asked if mission preparations were being considered to isolate possible experience from other space topics in terms of space vehicles to earth landing, vice, Pittsburgh said he envisaged a combined question of the sites to conduct contamination. He said that exchanges of information of this nature were to be made this June with the Soviet Union during the French-led Eastern Space Science Symposium and South Atlantic Meeting, COSPAR in Warsaw.

The panel was asked to comment on previous changes that scientific talent has been concentrated in the same government-sponsored space program at the expense of international exploration. They said that although many scientists might prefer more emphasis on the untrained program, the current effort has the popular support vital to the entire space program which they believe is producing scientific rewards and creating scientific excitement.

Prof. Martin Schwartzbach of Princeton University Observatory, addressing the panel, said that the scientific goals would result from the space program but that such significant results could include many others that have gone to be untrained and even aerospace accomplishments. He said that the space program had created an extraordinary discipline in education in all levels in the U.S., and further to be noted could be expected.

U.S. Tightens Space Experiment Planning

Washington—Difficulties with "scientific public relations" including environmental impact West Ford, nuclear fallout and "a rather open discussion regarding our handling of data from the Shuttle" (AW Apr. 15, p. 26), has led government to develop new formal procedures for studying "possible... direct and indirect adverse effects" before the experiments take place, according to presidential science adviser Dr. Jerome B. Wiesner.

Wiesner told the Federation of American Scientists Apr. 21 that he felt the government "acted in a completely responsible manner" in planning West Ford, but that there was "a breakdown in communication with some of the scientific community and, I am afraid, a somewhat irresponsible attitude on the part of some scientists, who were more interested in opening the experiment than properly assessing themselves to the public as to the facts of the matter."

He related to the community one of the probable release of 50 kilograms of copper needles expected to be launched shortly in the second part of West Ford. Dr. S. Fred Singer, director of the National Meteorological Satellite Center, estimated that they would remain in orbit 100 years while the government had not even been given (AW Apr. 22, p. 17). Singer criticized the government's handling of this and the Shuttle program.

Dr. Thomas Gold of Cornell University wrote recently that the really significant scientific achievements have always been unexpected and that NASA, by virtue of its position as a governmental agency, must operate in a very different way in order to justify expenditures in a way acceptable with usual scientific practice. He explained that space tests could not extrapolate future gains from space research out of presently accumulated knowledge. However, political pressures on NASA were forcing extrapolations of this kind from the available evidence.

Meanwhile, President Kennedy's support for \$37.5 million in Fiscal 1964 to build facilities at the Manned Spacecraft Center at Houston, Tex. He said before to start work this spring on an atmospheric re-entry test facility, including a landing and other facilities would be "serious, difficult and harmful" to the program.

Holmes and George M. Low, a deputy director, said tests to simulate land on the Apollo command module (AW Apr. 15, p. 26) would be in the sphere at speeds of about 11,000 mph are scheduled for the summer of 1964. The tests are to be made in an open field, using a 3-ft model of the 134-ton module.

Holmes said the investment in the Houston facility would total about \$1.5 million by the end of Fiscal 1963 and might grow to about \$2.5 million by the end of the decade.

Earlier last week, the subcommittee conducted a brief inquiry into the status of work on high-energy fuels. A J. Topping, manager of the Caltech Chemical & Nuclear Products Dept., argued that the U.S. undertake a "program with higher dollar value" for the development of high-energy fuels.

His firm, which has a production plant at Menards, Okla., has been producing a diamond-bonded brick block for jet engine nozzles, for the Air

Need Cited for Early Apollo Re-entry Tests

Washington—Critical tests involving Apollo re-entry tests must be made by the summer of 1964 if the manned lunar landing program is to stay on schedule, Brainerd Holmes, director of the program, told the House subcommittee on manned space flight last week.

Holmes appeared before the subcommittee on hearings into the National Aeronautics and Space Administration's support for \$37.5 million in Fiscal 1964 to build facilities at the Manned Spacecraft Center at Houston, Tex. He said before to start work this spring on an atmospheric re-entry test facility, including a landing and other facilities would be "serious, difficult and harmful" to the program.

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Force. The Air Force has set its funding of the government-sponsored plant and seeks eventually to put the plant in a particular state. Rep. James Easton (R-Pa.), a member of the subcommittee, was long argued NASA to show more interest in defense. Caltech's home office is at Caltech, Pa. As a result, the Air Force's preliminary design for the Shuttle's Reaction Motors Div., and a NASA-sponsored test program to determine the combustion efficiency of oxygen rocket motors and efficiency in a small rocket motor was completed late last year. Results of the 52 test flights were "outstanding," he said, though the study raised some important questions.

John L. Skop, director of propulsion and power operations in NASA's Office of Advanced Research and Technology, diagnosed with some of Skop's conclusions and said the Reaction Motors engine tests "were disappointing." He said that, unfortunately, the Air Force only a narrow range of studies that that engine testing is still a formidable unmet problem. Oxygen-fueled defense products transparency (AW Apr. 22, p. 17) and that these are no known materials that can withstand the heat, or minimal for cooling an engine using the fuel combustion. Skop said.

MA-9 Postponement

Bids to have tested in the space conditions of the MA-9 (AW Apr. 15, p. 26) have been postponed the flight of the MA-9 (AW Apr. 15, p. 26) to May 7 to May 14.

The problem, described by one source as "not serious, but not the sort of thing you ignore when a man's life is involved," was discovered at Cape Canaveral, Fla., when tests of the MA-9 showed higher than normal drift rates. Although the deviations were within tolerance, the rockets were tested and solid rocket motors were found in the guided vehicle.

General Dynamics/Aerometrics, after consultation, recommended more than 60 minutes at its San Diego, Calif., plant and found a small delay in several tests. National Aeronautics and Space Administration then ordered the three rockets (one flight and two backup sets of MA-9) to be MA-9 boosters, to be returned to the manufacturer, General Precision, Inc., for rebuilding.

Until the rockets are returned to Cape Canaveral, NASA will not conduct MA-9 flight (AW Apr. 15, p. 26) and the MA-9 (AW Apr. 15, p. 26) will be MA-9 boosters, to be returned to the manufacturer, General Precision, Inc., for rebuilding.

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Presidential Decision Is Sought for Nova

By Edward H. Korman

Dallas—U.S. has delayed a sizable fleet of Nova launch vehicles based on an analysis and advisory committee's development will be a national policy decision because it requires massive cost and engineering responses, according to Felix A. Stone of the National Aeronautics and Space Administration.

Devised studies of Nova possibilities made by industry and NASA clearly indicate that the vehicle will require a 3-9 year development period, and a development cost ranging from \$3.5 to \$4.6 billion, Stone said. The heavy launcher for a vehicle system constructed within the current U.S. capability. Top members see for an advanced launcher based largely on hydrogen technology and reusable boosters. General Electric, however, for all vehicles under consideration is the ability to inject 1 million lb payload into orbit early.

Stone, who manages advanced launch vehicle studies at NASA's Office of Mission Space Flight, reported to the American Institute of Aeronautics and Astronautics several mission space flight meeting held on preliminary aspects of studies under way for the past year. He said the program is in a very large range that in order to begin basic development, it probably will require the backing of President Kennedy with a national policy statement similar to that one he pushed for the Apollo mission. Large launch program will be accelerated two years ago.

Stone's report was the first of the unclassified studies, and featured three key points:

- **Program justification** depends on a decision to provide with manned planetary exploration, establishing a large firm base and a large space station.
- **Direct operating costs** above expense of refueling the engine \$1,000/lb. U.S. spends to refuel a payload to under \$200/lb. for Nova Saturn IB, which will start at \$1,600/lb. cost, will currently be reduced to \$1,000/lb. Nova S will start at \$150/lb. and level at \$110/lb.

- **Nova vehicle family** falls naturally in three classes—current technology based on F1 and solid propellant boosters with M-1 upper stages; hydrogen-boosted boosters featuring gaseous technology, and hydrogen-boosted boosters using advanced techniques to achieve high chamber pressure, advanced injectors, and more.

General Dynamics/Astronautics and Martin Marietta are competing studies leading to an "ideal Nova." Douglas, CD and Space Technology Laboratories are studying advanced Nova concepts,

based on concentrating on a solid boost vehicle, and Martin Marietta is studying launch facilities for the vehicle.

The presidential configuration in each of the three classes are:

- **Class 1-Liquid** version consists of a booster cluster of 10 F-1 engines uprated to 1.5 million lb each. Second stage is a three M-1 hydrogen engines. Vehicle would stand 410 ft high, be 80 ft dia., weigh 25 million lb, at take off and have a lift-off thrust of 12 million lb. Solid propellant vehicle would be boosted by four 300 ft dia motors with two or three M-1 engines mounted on the solid stage. The second stage would be 190 ft high, 60 ft dia., weigh 54 million lb, at take-off, and have a take-off thrust of 50 million lb.

- **Class 2-Vehicular** uses hydrogen propellant and solid stage. Solid stage is a booster cluster of 10 F-1 engines uprated to 1.5 million lb each. Second stage is a three M-1 hydrogen engines. Vehicle would stand 410 ft high, be 80 ft dia., weigh 25 million lb, at take-off, and have a take-off thrust of 50 million lb.

- **Class 3-This** would incorporate the most advanced concepts. CD vehicle features a high chamber pressure hydrogen-fueled booster. Martin Marietta, however, says the booster would be a solid stage. The second stage would be a three M-1 hydrogen engines. Vehicle would stand 410 ft high, be 80 ft dia., weigh 25 million lb, at take-off, and have a take-off thrust of 50 million lb.

All three concepts call for parabolic recovery of two and a half space frame. Stone said that a solid stage booster would be a feasible launch platform for advanced flight. Lave said that in order to land anywhere on the earth from any orbit, a lift/drop maneuver is required.

In another paper, Stanley Hagen of Hughes and George Tabata and Robert W. Hagen of STL reported on a Phase 3 report analyzing the direct and indirect costs of the Saturn I vehicle. Based on a branch rate of 12 vehicles per year, these costs will total \$3.5 billion over a 10-year period.

On this same development costs will total \$1.4 billion, production, \$1.1 billion, launch and ground overhead, \$110 million, and ground overhead, \$110 million. Total cost, \$1.4 billion, includes facility, \$58 million, support equipment, \$14 million, transportation, \$5 million, and propellant, \$5 million.

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and availability is a most desirable feature of future launch vehicles, and L. T. Spaul of NASA's Marshall Space Flight Center reported on a rocket-launcher analysis of the vehicle costs. Although Spaul's report contained a disclaimer that the options are not necessarily those of NASA, the author concluded that a horizontal launch method—using a ground accelerator (dual or single stage) to achieve a 50 ft step-up is preferable to a vertical launch.

Spaul's report, based largely on NASA-sponsored industry studies underway at Boeing, Ling-Tecnic, Lockheed, and Martin Marietta, examines the probability that non-rocket launchers will be required for large space stations and the lower cost, and the horizontal launch will require lower cost launchers than those.

W. B. Lorus of Chance Vought Corp. reported on launcher studies which strongly indicate that the pole's role can be greatly increased in controlling the launch of the two stage launchers would be there of these engines.

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Workers Reject New Boeing Contract

Washington—Boeing Co. was confronted with a major strike last week after the majority of International Assn. of Mechanics voted against ratification of a new three-year labor pact.

The vote ran 9,911 to 3,721. Workers at Boeing's Seattle facilities approved the new contract by a margin of 3,550, but it was rejected overwhelmingly at the company's Wichita plant and smaller site facilities. IAM leadership, which supported the new contract (AW April 22, p. 37), was disappointed to receive less than 50% support, particularly at Cape Canaveral, while it continued working with Boeing management. The main management objection was to the company's terms of performance analysis under which workers are paid every six months.

Last week Boeing issued a public statement which said "It should be made clear that Boeing has not agreed to improve the contract over what was agreed upon... and have no intention of doing so." Boeing will live up to its part of the bargain and expects the union to do the same. Otherwise there can be no ability to agree on a new contract at Boeing's Seattle plant.

The 10-day contract agreement, issued at Boeing under the Taft-Hartley law, expired April 15. The left the permanent without further labor recourse to avoid a strike. IAM membership at Boeing facilities totals approximately 35,000.

Proper Focus, Firm Goals Urged For U.S. Military Space Program

Dallas—U.S. military space program is bounding badly because it lacks a proper focus, according to Clifford D. Perkins, former deputy Air Force secretary for research and development.

Perkins, who also was the USAF chief scientist and currently heads the unclassified engineering department at Princeton University, told delegates at the American Institute of Aeronautics and Astronautics' annual meeting space flight meeting that the current program for the military runs at a space science level evidence from the Administration but they are poorly thought out.

As Perkins noted in his remarks on development objectives to arrive at a decision position in the national space program, Perkins stressed. He suggested that emphasis be placed on the Air Force, X-20 (Dyna-Soar), T-10 and a two-stage, reusable reconnaissance booster.

Shortly after this talk, Gen. Thomas S. Power, commander of Strategic Air Command, supported Perkins' remarks that the military space program is not clear. Gen. Power offered as a possibility for the first command mission in space an orbiting command and control station for global strike forces.

Perkins said the decision USAF space role is due to a lack of credible first-line mission, development of highly sophisticated manned space vehicles by the National Aeronautics and Space Administration, peaceful arguments over configuration of the space vehicle, power should not be developed equipment for use in military space that might require little evidence by the Administration, and large costs.

He said the only military mission is a

space force, and beyond that mission. "The military is going around in better state-of-the-art, better concepts and better analysis to develop military space missions further."

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space force, and beyond that mission. "The military is going around in better state-of-the-art, better concepts and better analysis to develop military space missions further."

Perkins' assessment of military missions, listed in his study of possibility, are: reconnaissance, early warning, communications, navigation and weather satellites, reconnaissance and intelligence, defense of U.S. space interests, defense against ballistic missiles, and defense weapons defense.

He said that it has been impossible, in fact, to make a convincing case for a manned military space mission. He added that the military is looking back into the 1950s, when the military was looking for a manned military space mission. He said that it has been impossible, in fact, to make a convincing case for a manned military space mission.

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McNamara Defends Decision-Making Role

Washington—National security decisions affecting forces and weapon systems must be made from a central point—the defense secretary—and not by a committee made up of representatives of the military services, according to Defense Secretary Robert S. McNamara.

"The nature of committee is to compromise their special interests, which is not the sense in making the decision from the point of view of the national interest," he told the American Society of Newspaper Editors here recently.

"Any secretary of defense must make certain kinds of decisions, not because he possesses his judgment to be superior to his advisors, military or civilian, but because his position is the best place from which to make those decisions," he said.

In a wide-ranging defense of his policies, McNamara stressed economy and the necessity for military requirements to be expressed in national requirements rather than those of the individual military services. But he defended the maintenance of separate military services over creation of a single unified service.

It is the job of the secretary and his staff to see that there is one policy, he said, just as it is the job of the President to see that the U.S. has one national security policy and not a series of conflicting policies in the State Treasury and other departments.

McNamara also defended his policy of limiting the number of weapon systems. "If we continue to develop the arsenal and engineer in the country into weapons development work we could still develop only a fraction of the systems that are proposed," he declared.

The proposed system must be streamlined, he said, and the process of choice must begin with a requirement that a proposed system would make a real contribution to national security.

He admitted that political pressures are applied to Defense Dept. officials when they discuss effect on economic interests. "Such pressures are an unfortunate and necessary part of a democratic political process," he said. "There are a good many advantages in forcing public officials to look to those outside their own staffs who do not share their views and assumptions."

"But it is the duty of government officials representing the national interest rather than any smaller interest, to stand up to those pressures where what is asked cannot be reconciled with the national interest."

When he entered office, McNamara found that the three services were establishing their requirements independently of each other. "Any planning, for example, envisioned a long way of attention, while Air Force envisioned a short notice war," he said. Consequently, the Air Force requested a requirement for stocking enough fighting supplies to last months in the event of a conventional conflict while the Air Force sought supplies only for a few days.

"The two combined could not produce a realistic sense," McNamara said. "What we needed was a coordinating strategy setting objectives actually achievable with the military resources available."

He found that such service had a different idea of what kind of defense preparations were most urgently needed and what kind of war would be fought.

The same problem was not by the services concerned weapons systems, he said. "There is nothing wrong in that it is inevitable. The services fight hard for their viewpoints. This is probably the greatest single advantage of having separate single services, instead of one unified service," McNamara said.

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CH-46A Helicopter Tested For Carrier Compatibility

First photos show actual carrier/helicopter compatibility tests using a Boeing Vertol CH-46A. Tests were conducted aboard the new helicopter carrier USS Oklauga (LPH-8) at the Delaware River. Helicopters were piloted by both Naval and Marine pilots, downed about 14 inches and go landings, and landed on all 10 of the carrier's landing spots. Closest one simultaneous eight helicopters on the flight deck, and 21 one be stored in the hangar deck. Oklauga is designed to carry a full battalion of Marines, with helicopter (being 35 troops into advanced combat area.



NOBREM Contracting

Washington—Selection of final contractor for the program definition phase of the mobile medium range ballistic missile (MMBR) subsystem was announced recently with the choice of the Martin Co.-Sylvania Electric Products for its team to work on the command and control subsystem.

Hughes Aircraft Co. was eliminated from work on this subsystem. Earlier, Hughes had been selected for another subsystem (AW No. 18, p. 46).

Reduced Dependability

He has been satisfied by the need to reduce the number of weapon systems. "Not only do the proliferation and complication of weapon systems reduce dependability, but they also are a major factor contributing to enormous costs," McNamara said. "The cost of equipment—equipment which is not subject to cost \$12 billion," he said.

It was this kind of consideration that had a great deal to do with the T-111 (TFX) program. McNamara said that the decision to substitute a single aircraft for the two the services had planned was the best move, rather than the choice of a contractor. That decision will save \$1 billion, he said.

Both contractors presented acceptable designs, each capable of meeting the military requirement, and with little to choose between them on the basis of performance," he said.

McNamara credited the personal acquaintance, when Thomas S. Gates, Jr., was defense secretary, for giving strong support to the Polaris and Minuteman ballistic missile programs. He noted that these programs have been successful since then, and that the number of nuclear warheads in the strategic alert force has been doubled in the last two years.



French Demonstrate Mirage 4 Inflight Refueling

Atguz 4 bomber (left) is the number 09 prototype which is being used currently by the French to test inflight refueling methods. Tanker, the Mirage 4, is the number 01 prototype which is being used by the French to test inflight refueling methods. Tanker, the Mirage 4, is the number 01 prototype which is being used by the French to test inflight refueling methods. Tanker, the Mirage 4, is the number 01 prototype which is being used by the French to test inflight refueling methods.

NATO Intercept Control Decision Nears

By Cecil Browlow

Paris—The final decision affecting the Lockheed F-106's capabilities as an interceptor and West Europe's defense posture in general is scheduled to be made within the North Atlantic Treaty Organization before the end of May.

Decision, which could have far-reaching political and military consequences, centers around the issue of ground-to-air intercepting control system that should be adopted for use within the NATO countries for intercepting aircraft and ground-to-air control system. As originally conceived, the system would have a single command and control system, from Paris, for all NATO countries. The system would have a single command and control system, from Paris, for all NATO countries.

The U.S., however, has not been in agreement that it should exercise its financial contribution toward development and maintenance of the system, although designated Nodge (NATO Air Defense Ground Environment), whose role would have been spending around \$100 million.

West Germany, in a related issue, has a concern for a control system to come with its F-104s now going into operational service and both that a control system is more desirable. As a consequence, it now is considering direct purchase of the General Electric

412L system, one of which already is in service with the U.S. Air Force in West Germany. For use on a national basis, an acquisition with an F-104 and Nike and Hawk, would be desirable.

NATO U.S. demand is that Nodge be modified and converted around a single, long-range system. West most of the policy discussion among from Washington rather than from American representatives in Paris. The U.S. has rejected proposals from other countries that the individual state be placed responsibility in order to reduce their vulnerability to direct control.

Another U.S. contention is that the F-104 at least the aircraft can be retained in a general sense of interception and then used on its individual target without being under control from the ground as the original Nodge plan envisioned. Instead the aircraft could use, proponents of the U.S. position say, its own relatively sophisticated radar-directed fire control system for the first link.

Paradoxically the U.S. is still anxious over its strategic goal to Europe and is unwilling to lead in this development to Nodge where it feels such a move is largely unnecessary. As originally conceived, the program would have cost an estimated \$300 million. Under its unaltered commitments within NATO, the U.S. agreed to pay 50-60% of this total cost for development and installation of Nodge.

Defense reinforcements and technical problems subsequently pushed the program to approximately \$600 million. The U.S. has been unwilling to pay for to accept this total in so far as its percentage interest is concerned and

stand reached off a series of the program as a whole within NATO last December.

What the issue will amount to when the decision between last year's month last suggested new concerns is then the four European NATO nations that have entered the F-104 a complex system that has been under construction in Europe since its selection in these countries in 1960 for a variety of reasons—none of them political.

Made from West Germany, the other NATO countries involved are the Netherlands, Italy and Belgium, the latter of which has been the most vocal over its concerns with the issue of Nodge. The Belgians are also chief of staff research, and that the U.S. has been Nodge would be virtually useless as an aircraft intercept.

The explanation, however, that the same would be true for any other advanced aircraft including France's Dassault Mirage 3 and England's English Electric F-106—two other competitors in the original competition with the F-104. He also said that the Starfighter would be "practically useless" as a fighter-bomber and reconnaissance aircraft with or without Nodge.

Some reports interpreted this as a first demand of the F-104 as a weapon system. The Belgians deny this and expect, but the explanation remains that they feel Nodge will be dead because of U.S. resistance to the cost increase.

That, in fact, the U.S. denies it. "We are not willing to support an 'acceptable' system unless at an acceptable cost figure."

Senate Role in Private Company Questioned in Comsat Firm Debate

By Katherine Johnson

Washington—Question of the propriety of Senate regarding, still into the affairs of Communications Satellite Corp., by confirming its 14 incorporators was raised in floor debate last week.

The law enacted last year to establish the corporation designated it as a "corporation for profit" which will not be an agency or establishment of the U.S. Government.

"The proposal that the Senate participate, through confirmation of most of the directors of this company, in the election of the management of a corporation which is wholly private in nature is unprecedented," Sen. Albert Gore (D-Tenn.) said.

The Senate last week rejected the Communications Satellite Corporation bill. Sen. Wayne Morse (D-Ore.) is a 75 to 25 vote, and then confirmed the incorporation by voice vote. The incorporation, sponsored by President Kennedy, will also be confirmed by the House of Representatives (AW May 18, p. 35).

The majority who questioned the constitutionality, as well as the propriety of Senate participation in private management expressed opposition that they had no doubts concerning the qualifications of any of the 14 incorporators.

Are Jet Engine Test

Electric arc jet engine which generates nearly 6,000 lb thrust with a specific impulse of 1,800 sec has completed a 720-lb test run at Avco's Research and Advanced Development Dept. without indication of significant deterioration, the company said.

The 34-day test, the longest not achieved by a space propulsion system, was a qualification test for the National Aeronautics and Space Administration's Lewis Research Center, Cleveland, which sponsored the development. Engine operated continuously except for brief shut down for a conceptual power supply and another after 200 hours at NASA airport, to check the thrust stand.

The engine, which weighs 5 lb, consumed 1,100 lb of hydrogen during the 34-day run and achieved an overall efficiency of more than 45%. Avco and the arc jet engine, which requires no liquid cooling, uses a magnetic, cathodic, anode and cathode. The hydrogen working fluid entered the engine as heated as it passes through the electric arc discharge, causing it to expand in a convergent nozzle.

Presenting their viewpoint, Sen. Gore said: "The whole procedure should be a matter of deep concern to all who support private enterprise and condemn what is frequently characterized as government interference in private business. The principle at stake is a far-reaching one."

"What about General Motors?" That point corporation has many government-owned owners. In the interest of the government which we ought to provide for presidential appointment or removal. Senate confirmation of most of the directors of this company."

Sen. Robert Kennedy (D-Tenn.) noted that the "obligation" of the director will be to serve the corporation's private profit interests.

The 14 incorporators will serve until the stock is floated and a new board of directors elected and appointed. Sen. of the director will be elected by holders of public stock, in the holders of stock available only to communications companies as they may be appointed by the President.

Some senators anticipated the nature of government participation in private enterprise will become more acute with the organization of the permanent board. They noted that it will involve whether the first levels of the three presidentially-appointed directors is to the President, and the Senate which will be required to confirm them, or to the private enterprise.

"Whenever the confirmation of a committee to the board of directors comes before the Senate, some member or group in the Senate may feel the necessity of requiring more full disclosure of the operations of the corporation," Sen. Gore said.

News Digest

Delta Air Lines placed a \$75 million plus order with Douglas last week for 15 DC-9 short-haul medium-range transports and spares. The airline also took an option on an additional 15 aircraft (AW May 22, p. 18). First delivery of the aircraft probably will be in 1966, although no firm date has been selected.

North American X-15 research aircraft will attempt to set a new world altitude record of 575,000 ft. The number Two has been scheduled to be made in preparation, the first in May to 200,000 ft., and the second in May, 1966.

Tu-114 Delays Pershing

Cape Canaveral, Fla.—Launch of an Army Matins Pershing missile was delayed 20 min on May 20 as an American Hawk-bound Tu-114 two days behind its normal schedule passed through warning areas W-497 A on the Atlantic. Missile Range.

Start of the weekend Tu-114 approaches the U.S. coast on a heading of 120 deg., missing the warning area about 180 mi north of Cape Canaveral. At 27 deg. north latitude and 70 deg. 30 min. west longitude a point 25 mi southeast of Puerto Rico the Tu-114 turns to a 180 deg. heading, continues to 24 deg. north, where it roughly parallel to Key West and then more southeast for the final leg into Hawaii.

The report from the American Agency for Defense Development, the Tu-114 is observed well in advance by the Radar and data which are collected at the Cape on Matins. The return flight on Wednesday could cause confusion, but the Pershing shot was the first to be actually in on its own a field. So different Tu-114 have flown the route and the intercept is nearly certain.

Part of the Pershing, the last at the Cape was launched May 21 but was postponed until after the following day. The Tu-114 missed about 1,000 ft. because of some technical problems. Then at about 7-5, the Tu-114 was picked up by radar and the kill order was issued. The missile was launched at 3,400 g and landed within 200 yards of its target.

Federal Aviation Agency reports to meet the May 1 deadline for submission of proposals to transport recommendations from the President's Council on Transportation (AW May 18, p. 35). The FAA data on the important transport was assembled last week, and the final report from the 10-day advisory committee was expected shortly afterward.

Piper Aircraft is developing a 235-hp version of the PA 25 Cherokee biplane engine. Customer preference has been leaning strongly in favor of light-piston engines in the aircraft.

The Hawaiian Blue Streak launches, which will be shipped by sea to Woomera Rocket Range in Australia, a new getting final check-out and adjustment at Spalderson rocket establishment.

Research Advisory Committee on biotechnology has been formed by National Aeronautics and Space Administration to review current progress and recommend future research in the field. Dr. Charles I. Birn, medical director of Lockheed-California and president of Aerospace Medical Assoc. is chairman.

U.S. Reveals Liberal International Policy

Long-delayed air transport statement stresses competition over demands for foreign carrier restrictions.

By Robert H. Cook

Washington—U.S. will employ a more liberal and realistic "free enterprise" philosophy in future negotiations with foreign governments under the new international air transport policy released last week. Details of the controversial policy were first reported by Aviation Week & Space Technology (Sept. 10, 1962, p. 55). Official disclosure of the policy was repeatedly delayed (AW Apr. 3, p. 48).

The policy statement, an unexpectedly brief and vaguely worded document of only 15 pages, takes the attitude that it is far more practical for U.S. flag carriers to gain their hopes for a greater share of the growing international market on their ability to compete, as opposed to demanding restrictive protection against foreign airlines. As a result, the U.S. will "oppose arbitrary capacity restrictions" or any abuse of capacity restriction permitted under the present Bermuda Agreement, the statement said.

"This would apparently work both ways, since U.S. flag carriers have now placed of significant capacity restrictions on their foreign competitors, and the U.S., in turn, has lapsed in several attempts to restrict capacity or reduce subsidies given to foreign carriers on North Atlantic routes."

The policy states that if the U.S. is unable to achieve at an acceptable capacity rate with a foreign government and capacity restrictions continue, the parties will be treated under "consultation arbitration," and in the last analysis, discussion and negotiation of a new bilateral agreement.

On the basis of this statement, most aviation experts are uncertain just how far the U.S. would go with such action or what arbitration response could be employed.

However, the policy that will be shown to foreign nations will not be the detailed discussion released in this country's information control. It will be the original 600-page working document outlining every detail of the policy. It will provide a powerful bargaining tool based on the value of the U.S. as a market for the balance of the world's airlines, these sources said. It can be expected to exert a strong influence on U.S. attempts to "persuade" more competition from foreign governments. The complete document will not be released to the public, they said.

Generally, the policy does not even contemplate any stage changes, preferring to retain the basic working framework of the old policy, but placing more emphasis on strong government action effectively.

In a bid to retain the status quo of

the international airline structure, the policy announces that it will "hold the line" on air lanes, and it goes on to say it will make negotiations with foreign governments retain a balance of U.S. flag competition across the North Atlantic, offer the idea of airline pool agreements, have cargo rates, developing a system of user charges to apply to all international carriers, and give greater emphasis to foreign and needed to develop internal and regional aviation programs.

Several portions of the statement seem to indicate that the proposed Pan American World Airways Trust, World Airlines merger will be turned down by the White House, and that the formation of such European pools as Air Uropa might be abandoned if the merger is not approved.

"Government facilitation in negotiation international political and technical policies would be reduced if the

interests of any single carrier become, over the long run, too dominant a factor in U.S. aviation policy," the statement said at one point.

In another area, the policy said, "we should continue to aim for a U.S. carrier system in which one U.S. flag carrier has access to world markets on a scale comparable to that of the flag carriers in combination of the major and other major and minor powers, and other U.S. carriers continue to be authorized to serve one or more areas of the world in overall competition with such carriers."

While the policy noted that the aspect of ranges was not taken into consideration, and neither Pan Am nor TWA were identified, some observers concluded that the policy contemplated keeping these carriers on their present lanes, with an idea of realigning their routes later along lines suggested by the Civil Aeronautics Board. CAB earlier recommended that Pan Am and TWA be kept on their present routes, with Pan Am and TWA to be kept on their present routes, with Pan Am and TWA to be kept on their present routes, with Pan Am and TWA to be kept on their present routes.

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Douglas Mystere 20 Transport Rolled Out

Douglas Mystere 20 two-prime executive transport was rolled out recently at Douglas's Rockdale assembly plant. First flight of the aircraft, designed to carry from 8-18 passengers, is scheduled for May. All loadings-included request on this flight & Whitey J112-1-1000 engine rated at 1,000 in thrust only. Aircraft is designed for flight over range lengths from 318-1,000 mi. at 447 kt.

technically become obsolete, available only to Air Union members. In turn, U.S. flag carriers would have to compete over the North Atlantic in this bid to keep the U.S. flag carrier in the market. As an example, TWA, which has traffic rights between Paris and Rome, could be forced to drop this traffic and terminate its Atlantic flights at Paris.

IATA Fares

Current international disagreement over CAB refusal to approve an International Air Transport Act has been one of the major issues in the U.S. debate on the new international aviation policy. The Board's rejection of the IATA fare is the first time any government has taken such action since the original act was formed. Foreign airlines to the United States would be required to accept a decision, that is, the existence of a 5% increase in existing international fares.

Taken as the U.S. is to reach a new agreement with the foreign governments on this issue, would U.S. flag carriers be able to change the higher rates or risk the possibility of being reduced rates in return for foreign passengers. Should the higher rates be accepted, it would be a two-consumption and cost-sharing of bilateral agreements with the countries involved.

North Atlantic Route

Noting that the present network of international air routes is fully developed, the policy will strive to limit the number of carriers on such routes.

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BEA Trident Order

London—British European Airways has ordered six Boeing Trident 1C aircraft, the first of which is expected to be delivered in the next few months. The order was placed with Boeing Co., Seattle, Wash., for six aircraft, each with a capacity of 40 passengers.

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CAB 'Goals' Report Draws Little Support

Washington—Civil Aeronautics Board's attempt to formulate long-range aviation goals has stirred a storm of controversy among CAB's own staff experts, the basic airline industry and many government offices.

The report's major recommendations are the more intensive U.S. bargaining with foreign governments in a series of negotiating foreign airline competition, relieving competition between domestic airlines by permitting only two carriers on a route, adding or fewer as low as recommended, possible new routes and possibly relieving present route quotas to provide more balanced competition, and a long-range reduction of local service activity.

Consensus on a first draft of the report "Goals of the CAB" indicates that individual airline positions will be little affected by its recommendations.

Unwavering rail resistance to either support or oppose competition and regulation is dictated by their own interests. Local service airlines face a reduction in subsidy, a most acute point, from trunk routes, but support for such would indirectly raise their subsidy allocations at a fast rate. International carriers support the report's findings of more foreign competition and favor a stronger U.S. defense of their needs. Reversing the industry's sentiments, which were made by CAB Planning Officer David Blumstein and the 30 detailed replies received from the 302 organizations contacted, the CAB staff concluded that the report con-

tributed too much upon improving the financial health of the airline, as opposed to providing greater benefits for the public, and that many of the means needed are not supported by facts and can only be decided by the CAB after a full presidential hearing.

Threatened to lose seats
Reduced competition. The pending American-Egyptian merger and North-American bid to merge in Florida routes probably accounted for the intense opposition to the report's recommendations that competition on many routes be restricted to only two carriers. Six airlines opposed the idea, five carriers and two government agencies disappointed and two other carriers were not reached.

CAB staff disagreed with the goal stating that "assumptions can exist only under circumstances in which only one possible outcome is probable; competition in and of itself cannot inevitably constitute a barrier during times two periods in some markets. As a matter of fact, it is the pressure for relief from this burden that provides the impetus for the large air companies and technological advances necessary attributed to competition." The staff termed the proposal as over-simplification of a complex problem. "Under contract" through routes was also attacked by the CAB staff, which doubted that this would be an improvement over the present method of establishing routes. In addition, the staff said, "assumptions of a market plan" could result in "unbalanced carrier interests." The staff said, "It is questioned, therefore, whether the desirability of mergers in itself constitutes a goal." The staff also noted that the report's recommendations are only one means of route regulation.

International competition and U.S. bargaining. The report's recommendation that U.S. bargaining power also come under staff fire because of the new U.S. interests in international transport policy. The staff said that the report's recommendation that the U.S. make greater use of its superior bargaining power. The "Goals" report should first be revised to agree in such as possible with the international policy, and then become more specific in pointing out how the Board believes the objectives of the international policy can be realized, the staff said.

The superior bargaining power of the U.S. is threatened, however, as the traffic balance could shift and U.S. aircraft production facilities are becoming increasingly dependent upon world aviation markets. The long-range need being of U.S. air transport will be best served by policies which will enhance the competitive position of U.S. carriers, rather than by restrictive

actions which will inevitably create re-balancing necessities."

Subsidy recommendations brought a report of earlier studies but both trunk and local service airlines feel the report's recommendations are "in the other direction," explained the "importance of maintaining balance of American dollars in foreign and to sustain of questionable and even losses locally while at the same time adapting a purely artificial trade remedy is ineffective of these difficulties for transportation and to some of our own American competition."

CAB staff comment on the question stated that "the goal of reducing subsidy as a portion of budget subsidizing could result in a higher rate structure service pattern or equipment complex relative to the budget, as indicated, is a reflection of previously defined and utilized goals."

Low cost levels. Air transport is not free to be a rate competitive market as suggested by the Goals report, would not exist in a competitive industry, the staff said. The report's recommendation that further study be made of the effect of various forms on traffic growth. In particular, the staff explained, the Board should keep personnel free "under contract" through routes as they are based upon immediate procedures may be inhibited to protect airlines that might be adversely affected.

Passenger fares are almost always reduced. The staff said that if they are based upon immediate procedures may be inhibited to protect airlines that might be adversely affected.

Safety. The report attacked an increase of Federal Aviation Agency and CAB as safety enhancement functions and should be amended to include this information, the staff concluded. Long-range studies for an safety should also be extended to include FAA and other pertinent such as military, space and communications agencies, the staff added.

Air-India Decision

An India has denied that it will rely on U.S. aircraft for its new long-range jet for the next 30 years. Cited by Press & Whiskey 770243, the airline is in its newly-ordered Boeing 707-300, seeking more seats than is available with 707-300 aircraft.

Air India also has considered leasing a Boeing 707-300 which was damaged by a fire last December at Bombay's Santa Cruz Airport. The airline is in a long-range study to decide whether to lease or buy the aircraft, which would be used to return its Panagra shares, perhaps



Third 727 Makes First Flight

Third Boeing 727 transport made its initial flight recently from Rome, Maryland Airport. The plane was airborne 2 1/2 min. during which time ground performance of the aircraft was checked. At the same time, the first 727 completed flight structural dynamic testing tests. First two 727s have logged over 100 hrs. of flight test time.

Pan Am-Panagra Move Opposed

Bozell International Agency will oppose the Pan American World Airways acquisition of Panagra, a move agreed to by the W. H. Green Co. as a preferable alternative to a long period of uncertainty awaiting disposition of the Pan American air transport portfolio.

Because of the unavailability of the attitude of the Civil Aeronautics Board to the acquisition, Panagra at the time has a wishful to drop its interest in local operations from Panama to the U.S. state and use assets on the South American Route Case now before the Civil Aeronautics Board.

Green once half interest in Panagra and Pan American, the other half. The Dept. of Justice had been long-term decision that would have acquired Pan American to meet its Panagra interest, but the Supreme Court decided the case and returned it to the Civil Aeronautics Board, ruling that the Board had the authority to decide such air transport issues and that the Board should use the authority in this case.

Compared with Green's recent sale of Constellation, the Panagra move has raised questions of whether Green may be involved on a general policy of disposition of discredited subsidiaries to concentrate on its chemical interests. Green, however, appears to be more concerned with the uncertainties and risk of the air transport case but also those presented by the rate case if it chose to return its Panagra shares, perhaps

attempted to buy out Pan American. Board President Charles E. Bozell said that the sale would give Pan Am a preferred U.S. flag transport in South America and would have a U.S. government efforts to resolve South American air transport problems.

In its petition to the Board, Pan American contended on the other hand that the sale would eliminate the dual

ownership with two problems, simplify the CAB's ability to deal with the South American Route Case and would not implicate the Board's ability to protect general Pan American air traffic in other ways.

Some effort for a Bozell-Panagra merger had been made, but has since been dropped. Bozell and Panagra separately on South American route control. But Panagra's authority made at the Civil Aeronautics Board and it seems there through an interlocking with Pan American, many Panagra equipment and assets and Miami-New York through an interlocking with National Airlines. Pan American across the east coast of South America.

Terms of the sale call for either a cash payment of \$10,000,000 for the 40,000 Panagra shares owned by Green, or 991,000 shares of Pan American stock. The cash price is in effect, a minimum above the market price of the 991,000 shares amounts to approximately \$11,000,000.

Panagra has reported a net profit of \$1,260,000 for 1962 on revenues of \$23,525,000, an increase from a profit of \$1,000,000 on revenues of \$23,440,000 for 1961.

The asset conditions of involved by Green of Pan American, the agreement provides for the stock to be held by a trustee—a New York bank or trust company—and voted in the majority of Pan American's stock is voted in its vote. 80% of the stock, by Green also carries restrictions to prevent block larger than 25,000 shares being sold to any single interest.

The staff will continue to be operated independently, with no change in its present status in employee status, until the Board's decision.

Pan Am Shows \$15-Million 1962 Income

New York—Continued efforts to reduce passenger fares and raise rates have been advanced by James T. Topp, president of Pan American World Airways in his company's 1962 annual report.

Report stated that Pan American had a net income of \$15,007,808 in 1962 compared with \$13,377,000 in the previous year.

Topp said that if Panagra air carriers and other governments would accept reasonable reductions in transportation fares, "everybody would gain."

Although Pan American's share of transatlantic passenger declined from 24.5% in 1961 to 23.1% last year, the airline still commanded an 18.4% increase in gross wide passenger miles flying 4,955,000 miles. Passenger revenues of \$20,100,000 were 9.4% greater than in 1961 while the system had fares defined one point to 1961.

Carrier's net operating revenues of \$20,115,000 was \$4,549,000 more than in 1961 and marked the first time these revenues exceeded \$5 billion. Operating expenses, measured \$24,112,000 to total \$9,997,000.

Corporate sales taxes increased 23% in 1962 with Pan American now claiming a tax credit from the air cargo losses of its direct competition.

Pan American extended the aerial life of its jet engines from seven to 10 years in 1962 resulting in a \$1,400,000 reduction in its disposition expense for the year. The report noted, Green also reduced its interest in subsidiaries to \$1,250,000 through purchase of equipment defective under the new investment credit system which became effective last year.



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UNITED

THE EXTRA CARE AIRLINE

American Pilots Union Seeks Recognition

By James R. Abood

New York—Allied Pilots Assn. filed last week for National Mediation Board recognition as the bargaining agent for American Airlines' 14,000 pilots after receiving representation rights from 77% of the current cockpit crewmen.

Nicholas J. O'Connell, an American captain and temporary president of the new union, said more than 1,200 ballots had been received from American pilots seeking a breakdown from the Air Line Pilots Assn. (ALP) Apr. 15, p. 41).

New union needed only 51% representation from the pilots to establish its claim as the new bargaining body. However, O'Connell said that considering the American pilots' general dissatisfaction with ALP, he would be surprised if 95% did not align themselves with the Allied Pilots Assn.

Reaction from the pilots came even more quickly than was expected, O'Connell said. The 77% acceptance was acknowledged only 21 days after right-to-represent ballots were mailed to American pilots on Apr. 12.

Still to be pulled are the senior flight engineers, who represent 4% of the pilot group. The engineers technically are management personnel, although they belong to the pilot union, and American's management has requested them to stay out of the dispute with ALP. ALP's position, however, would also be kept away by 90 American pilots on leave for military reserve duty.

ALPA Conflict

Conflict with ALPA arose after it refused applications of a new contract favored by American's pilots. ALPA's primary objection is that the agreement, which provides for three rather than four crew seats, does not require flight engineers to hold commercial and instrument pilot ratings (AW Feb. 25, p. 42).

American pilots stated that the ALPA requirement existed in its Turboprop and Jet Study Committee recommendations, a requirement. Even so, critics who have adopted the provision in crew contracts, the pilot-engineer is never allowed to fly, they say.

Consequently, they want the expert trained in an efficient manner for navigational duties. Such training would cost American approximately \$5 million rather than the \$20 million needed to train pilots of the 60% requirement.

American, in turn, would pass on this saving to the pilots by reducing monthly flight time from 55 to 75 hr., with no member in pay, plus added insurance and retirement benefits. Engineers would receive general increases in wages and fringe benefits, and pilots would not have to pass the physical and proficiency requirements required to obtain pilot ratings.

More to establish the new union is proceeding and court action initiated by ALPA and the Flight Engineers International Assn. to block the proposed contract. FEIA entered the dispute on grounds that its members, if American, in being denied the flight ratings which are needed on some airlines, face a threat to future job security.

ALPA is asking for an injunction that would prevent American's management from signing the contract. FEIA was awarded a temporary restraining order prohibiting the American pilots from even discussing the contract at their meetings. The new law on that order must be filed Thursday, however.

Hearings on the injunction request are before Judge E. T. Swift in Federal District Court here. The Allied Pilots Assn. has retained Martin C. Sikes as its counsel and has established a temporary headquarters in his office in New York.

Among those questioned in the hearings has been Charles Rabe, president of ALPA. Rabe testified that ALPA felt it was not being properly advised of progress toward the disputed contract, and acted only after learning of the evolution of flight engineer pilot training.

The filing of adequate claims led to ALPA's demand of Ralph L. Haddock its senior negotiator and the union's representative at the American contract negotiations.

Haddock was planning last week to contact his dismissal before ALPA's appeal body. O'Connell said Haddock was an extremely popular figure among pilot groups, and that pilots on American and other airlines were upset over his dismissal. O'Connell supported Haddock's claim that ALPA was kept fully advised of the contract negotiations.

O'Connell said no problem was expected in proving American Airlines' recognition of the new union. It was also hoped that pilot acceptance of the union would lead to demand of ALPA's petition for an injunction against the airline's agreement to the proposed contract, since it would no longer be considered members of ALPA.

American's pilots, who normally fa-

vor approximately 15% of ALPA's annual dues, have paid no dues since the contract dispute arose.

O'Connell said three other members of the negotiating union are being threatened with expulsion from ALPA for their stand. O'Connell did not appeal his expulsion, stating that he acted in the pilots' best interests.

At its organization of the new union, O'Connell said it is planned to conduct all elections on an individual ballot basis, rather than by delegate vote as practiced at ALPA conventions. ALPA convention delegates are chosen by local groups on line to vote in union officials at the conventions, but are also allowed to demand the change if, at their expense, local developments require a vote.

Although no decision has been made as to the amount of dues paid by Allied Pilots Assn. members, spokesman for the new group felt this will total somewhat less than the amount now paid by American pilots in ALPA. The smaller amount would be required, they said, because the new union would not have the extensive framework of ALPA.

Court Action

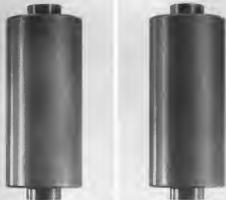
In view of the FEIA court action against the proposed contract, American's flight engineers were not asked to vote for formation of the new union. Should Allied Pilots Assn. become the new bargaining agent, spokesman said, the flight engineers could either join it or undertake their own contract negotiations through FEIA representation.

O'Connell said there are no plans to select members from other interests.

The flight engineers on American are primarily concerned about job security. Although they had agreed to negotiate a new contract jointly with the pilots, flight engineers' spokesmen said they were worried by the pilots that ALPA would ratify the pact. It was planned to assign the flight engineers into ALPA, with adequate pilot protection, men say.

Engineers say that no such assurance has been offered them by the Allied Pilots Assn. Although the proposed contract includes them, the engineers say their position would be strengthened with such contract renewal. Instead, they want the permanent security provided at current contracts signed with other carriers.

Engineer spokesmen hold reservations against the Allied Pilots Assn. in this respect. They say pilots on the last week of the new union at a meeting a device for signing the proposed new contract, and that the pilots can now act to reject ALPA.



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U.S. Airline Assets and Liabilities—Dec. 31, 1962

(In thousands of dollars)

	Total Current Assets	Investments & Changes	Property & Equipment	Total Assets	Total Current Liabilities	Long-term Debt	Retained Earnings	Stockholder Equity
INTERNATIONAL & DOMESTIC TOTALS								
American	222,713	33,319	411,493	667,525	116,188	340,529	21,431	120,597
Boeing	24,126	4,111	41,427	69,664	12,149	34,203	9,208	18,704
Continental	1,107	14	2,777	4,902	1,102	1,102	2	1,499
Eastern	22,411	2,399	41,494	66,304	15,455	46,348	2,799	27,800
Delta	42,289	1,103	127,101	170,493	30,474	101,419	35,444	40,111
Eastern	89,422	25,094	231,423	345,939	171,128	171,128	84,832	1,264
Northwest	440	470	1,423	2,333	324	1,004	11,045	12,829
Southwest	22,241	10,840	15,374	48,455	22,241	26,214	8,791	1,001
Trans World	1,349	3,102	14,401	18,852	12,415	6,437	18,776	29,713
Western	46,422	12,100	122,144	180,666	28,447	78,014	16,776	29,713
Allegheny	12,115	2,102	18,202	32,419	12,115	12,115	11,822	1,582
Pan American	119,261	26,304	304,564	450,129	166,838	244,291	29,708	130,247
South Pacific	348	100	107	555	348	1,218	5,431	5,431
Trans-World Express	4,281	2,480	14,407	21,168	4,211	14,272	204	4,119
Trans World	151,261	36,118	347,443	534,822	119,324	220,720	8,201	81,490
United	128,445	24,291	408,209	560,945	118,430	379,193	44,504	109,115
Western	21,200	4,283	67,638	93,121	18,246	59,448	4,414	12,000
Total & International Total	1,013,485	209,344	2,273,467	3,496,296	594,139	1,241,207	321,034	416,424
LOCAL SERVICES								
Allegheny	2,492	1,420	13,464	17,376	4,422	16,771	203	2,240
Boeing	1,340	409	2,410	4,159	2,422	4,401	267	2,319
Continental	2,379	370	2,043	5,112	1,149	1,149	4	106
Eastern	1,111	240	4,743	6,094	2,231	2,231	6	2,330
Delta	1,894	914	4,109	7,017	2,239	1,007	1	2,443
McGraw-Hill	2,418	1,009	2,799	15,306	5,444	8,807	103	4,144
Northwest	1,422	329	9,274	14,213	4,219	1,104	184	2,241
Southwest	2,455	266	4,270	7,010	2,340	2,340	71	1,849
Trans World	2,285	449	6,149	10,472	2,444	4,917	41	3,844
United	4,412	419	10,544	15,444	7,186	4,414	111	4,411
Western	2,400	247	3,234	5,903	3,449	1,212	14	1,303
Trans-World	1,170	218	3,422	4,239	3,426	1,192	142	1,280
West Coast	3,114	369	4,404	8,141	2,419	2,419	8	2,999
Local Services Total	41,460	7,710	52,245	106,715	49,408	21,797	1,345	19,140
ALLEGANY & ALLEGANY								
Allegheny Airlines	1,728	1,208	7,007	15,943	3,805	5,441	341	1,472
Allegheny Airlines	797	177	1,272	2,146	749	340	40	879
Allegheny	1,931	103	4,491	6,414	1,419	1,299	1	1,443
Continental	1,109	16	619	1,744	344	40	4	349
Eastern	2,022	294	5,165	8,291	1,455	2,964	84	1,294
McGraw-Hill	1,104	33	103	234	18	71	1	179
Northwest	1,214	329	9,274	14,213	4,219	1,104	35	1,443
Southwest	2,369	271	12,344	14,444	2,474	1,226	480	2,174
Trans World	1,127	461	1,126	2,274	60	17	4	1,840
Western	1,103	14	102	244	344	40	1	124
Allegheny	1,441	104	1,472	2,441	1,299	734	41	1,000
Allegheny & Allegheny Total	12,491	6,241	29,737	44,464	14,418	20,444	8,441	12,400
INDEPENDENT								
Chicago	1,363	49	443	1,855	201	1	30	1,403
Los Angeles	1,194	109	3,114	4,414	413	2,244	11	1,207
New York	1,201	194	3,114	4,414	1,120	1,274	11	1,279
Independent Total	3,758	1,052	7,671	10,743	3,734	4,515	51	3,944
CARGO & OTHER								
American	241	348	195	784	494	470	7	201
Allegheny	61	12	183	256	101	40	4,701	4,701
Boeing	1,418	4,403	40,413	46,234	10,413	42,400	1,201	14,201
Continental	1,413	101	7,114	8,628	4,414	2,704	1	1,201
Delta	4,408	2,112	24,414	30,934	11,413	30,414	1,414	3,414
Eastern	4,401	7,413	24,414	36,234	4,413	23,413	308	9,211
Cargo & Other Total	10,494	17,231	120,413	148,138	39,181	118,440	8,404	34,444
Industry Total	1,127,241	219,344	2,403,109	3,749,694	672,639	1,481,794	340,774	451,424

1. Preliminary report.

2. As of Jan. 31, 1963.

3. Loss.

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SHORTLINES

AIRLINE OBSERVER

► HIV-positive travelers are being kept under close surveillance in the U.S. in cooperation with most Latin and Central American governments. Passports issued by these countries now indicate whether the holder's application to enter Cuba has been approved or rejected and a rejection is enforced rigorously. The Mexican government has indicated that it may also reject visitors.

* From World Airlines estimates it will collect \$2.6 million (rather than pay back \$3.1 million as indicated by a Civil Aeronautics Board estimate) in deconvos as the 10-year-old Transatlantic Fuel Mail Rate Case (AW Apr. 19, p. 52). The deconvos, including rebates paid to TWA from 1946 through 1952, is subject to adjustment for income tax periods and rate of return on investments. Board approval of the costs of a 1953 "survivor's" strike could increase the sum payable to TWA beyond \$2 million, the airline said.

► Acrobatis is testing autonomous landing devices that take over at 1 100 ft, on turn to final approach down to flarout and touchdown. Procedures currently call the pilot to take manual control at 100 ft. The *Boeing* carrier has completed a number of completely autonomous landings with an F-18. *Boeing* test pilot Ross Vallee. Some landings were made in conditions of fog and strong cross winds.

* CAB may be joined to expand the scope of its current investigation of North Atlantic discount fares. The American Society of Travel Agents will ask to intervene in this case on the grounds that current charter regulations discriminate against the general public and encourage "illegal subventions." Every one should have the benefit of lower fares, which are now limited to consortium member charter benefits. ASTA contends.

✶ Airline industry is interpreting a writ of *habeas corpus* application from Nigro as a result of last week's Supreme Court decision upholding the claim of a Nigro pilot for a position with Continental Air Lines. The decision upon a ruling by the Colorado Supreme Court, which held that state law for employment level could not be applied to interstate carrier. Supreme Court ruled that all state law on segregation have now been held unconstitutional. The case began six years ago when 12-year old former Air Force Capt. Marlene D. Grooms applied to Continental for a pilot's job, was cited as qualified, but never was hired.

* Federal Aviation Agency awarded more than \$8.5 million in research and development and equipment contracts last month. Largest research and development items were \$575,512 for DME (distance measuring equipment) ground station equipment awarded to the Wilcox Electric Co., of Kansas City, Mo., and \$495,566 to the Goodrich Aircraft Corp., Akron, Ohio, for an airborne radar data collection system.

► **Friendship International Airport continues to lose business to Washington, D.C.'s new Dulles International Airport.** February traffic figures show that the Baltimore airport's passenger traffic declined 27% compared with February, 1962.

*Tartans and other airlines are helping establish air freight inventories to fight increasing competition from independent "gyro" brokers who often provide lower rates for warehouse-to-airport cartage. The airline is working efforts to several shippers, pointing out that its cargo liability insurance can not cover freight handled by the independents.

*Michael Aronson, new owner of New York's LaGuardia Field is being provided on a nonexclusive basis. C&D initially estimated that it would require \$176,000 for the tower under the old and new plan, and said that much of the cost would be unrecouped. The union, which originally estimated an extra \$400,000 need of \$21,000 for the station, later estimated that it would cover a profit of nearly \$400,000.

■ British European Airways' average traffic grew 11% for the fiscal year ended May 31. Passenger traffic increased 31.7%, freight 17% and mail 20% over the previous year. Station load factor rose to 82%.

► **British West Indian Airways** plans a 55% cut in Miami/Jamaica fares. If approved by the Civil Aeronautics Board, the fares would go into effect May 12 on five flights weekly from Miami. Ticket cost would be reduced from \$66 to \$49 on summer excursion fares and from \$327 to \$69 on winter fares.

► Eastern Air Lines' new Florida schedule effective Apr. 28, will provide 3,000 daily jet seats between Miami and New York. One way jet coach fares will be \$35.19, a saving of \$28.56 over current fares, and jet air, first-class service will be \$75, a saving of \$21.79. These fares would apply only to round trip itineraries of 7 to 25 days.

► **Phing Yung Lee** has been awarded additional MATS contracts totaling \$1.2 million for the month of April. Contracts cover the movement of cargo to Pacific military bases.

► Frontier Airlines has reported a net profit of \$181,428 for the first quarter of this year, compared with \$72,718 for the same period of last year. Profit was earned after provisions for \$126,000 in taxes and \$25,900 returned to CAA under the profit-sharing provision of the last year rate-of-return plan.

■ **Local service carriers** now may trade \$100,000 in air travel service credits for advertising goods and services. Possible condition of the industry, limiting its ability to purchase advertising, was cited by CAB when it voted to increase the trade agreement maximums from \$100,000.

► **Pan American World Airways** begins the first American flag service to Yaguajay on May 2, with twice-weekly flights to Bolanda.

► **Turns World Airlines** will handle tickets and information on the New York World's Fair of 1964-65 throughout its entire domestic and international system.

► United Air Lines is cutting its southeastern regional offices for flight operations and communications from Washington National Airport to Dallas International Airport.

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characteristic	typical	min	typical	max	unit	
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—	—	400	—	—	Hz	
—	—	500	—	—	Hz	
—	—	600	—	—	Hz	
Maximum Pulse Repetition Rate (PRF)	1000	—	100	—	Hz	max
Form factor (100 Hz to 1000 Hz)	—	—	0.1	—	—	typical
(10 to 1000 Hz to 1000 Hz)	—	—	0.2	—	—	
Maximum Duty (1000 Hz to 1000 Hz)	—	—	—	—	—	typical
(1000 Hz to 1000 Hz)	—	—	—	—	—	
Maximum operating current	—	—	10	—	mA	max
Max. Max. Operating Current	—	—	10	—	mA	max

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[illegible]



GENERAL ELECTRIC T55-GE-5 turbo-shaft engines, rated at 1,250 shp, are shown in final assembly at GE's South Allentown Engine Dept. Roundupping of the area is one major factor in progress toward zero-defect production, according to charts at the end of the line.

Service Experience Leads to T58 Changes

By David A. Andersen

West Lynn, Mass.—Ingress and diffusing helicopter operational control events have been major factors in service experience with General Electric Co. T58 turboshaft gas turbine.

High-frequency, short-flight patterns of commercial helicopter operators have focused attention on problems which, like engine wear, are functions of time in the number of starts and shutdowns.

In contrast, augmentation hovering near the surface of the sea, which is characteristic only of the Navy's anti-submarine warfare mission, has presented a different kind of problem: engine resonance due to shaft-torsion angles.

This problem, attributable directly to the mission environment it is not expected to turn up in helicopters based on other sites. But Navy and GE have specified material and process changes on top of routine preventive measures to overcome the problem.

Even these two divergent sets of the gas-turbine helicopter, GE and the customer, have learned much about the service qualities of the T58. With a total engine base now approaching 210,000 hr, comparison on the T58 project under Walter S. Burton at GE's South Allentown Engine Dept. has been that the major troubles have been fixed and mended.

These engine problem areas plagued the early development and service of the T550 hp engine, plus a number

of stress runs of the type expected during the first few thousand operating hours.

Reliability of the fuel control system probably has been the most serious of these difficulties. One GE engineer and one of the toughest argument he had to contain when he had to sell the engine to a prospective customer.

Early seasons of engine malfunctions showed that 54% were caused by the fuel control system. The symptoms were slow acceleration of the engine, as a cold lagging at the start. Sometimes the fuel schedule would shift without warning and change the engine power. Shaft-torsion subsiding went on, and the throttle valve stuck. The fuel filter clogged and allowed contaminants from the tanks to get inside the engine.

The problem concerned the Navy as the customer refitting the system requirements. It also led to Hercules Standard Div. of Allied Aircraft Corp., which was responsible for the detailed engi-

neering design of fuel-system control components under GE specifications.

Turbine fuel shutoff in commercial operations of the Sikorsky HO4S, and began to grow serious about the time of the Board of Inspection Sashes (BIS) trials of the SH-19. The three engine actions attacked the problem by making even field mods and making even to case each specific trouble.

Gradually, an improved fuel control system evolved from the many models. The main drawback against the turbine of the sea and at land conditions are right, the fuel flow up with changes and operation shows toward the engine intakes. The engines leave these parties along with the air.

Self Deposits
Salt deposits have on the first few stages of the compressor and cause the performance loss because they change the aerodynamic shape of the blades. The result is a change in compression flow characteristics which reduce performance. This situation was corrected by redesigning the air inlet area. The fuel line was attributed to air breaking off the blades returning them to their original shape.

First attempt was to solve the problem by making the air inlet the blades with fresh water. After the engine had cooled, Navy ground crews would run a spray on its start, and spray two or three gallons of fresh water into the inlet followed by starting the engine and running it at ground idle for 5 min to let out the residual water.

During engine shutdowns, after the rain, the crew sprayed fresh salt 600 on salt-water spray, into the inlet to make a wet water membrane on the blades or start.

But this was only a temporary fix, and it didn't get at the real cause in the engine—erosion started by the salt

residue. In the engine in the field, the engine was replaced with a new one. They were lubricated with Fluorinert, a synthetic grease, and overhauled in service.

Final solutions were changes in the design and materials of the engine and its drive gas. The engine control was changed to prevent the engine from running at low speeds. The engine material was changed to AMS 6350 steel. Increased hot-hold was designed into the engine and the tooth design was altered to give it a curved shape.

Spline Engagement

Full engagement of the spline was specified rather than the partial engagement of the engine design. A defect at the shaft and was reduced in diameter to allow design seating of the spline and a hole was added to retain spline lubricant.

These engine problems have been unique to the Sikorsky SH-19. It showed up as a noticeable engine power loss during sub-sea operations. The engine, which the aircraft was hovering at low altitude near the surface of the sea. On the engine back to base, there would be a partial surge of the power loss. More of the loss might be recovered the next day, when the engine was brought up to full power.

After engine analysis, the trouble was traced to salt water ingested by the engine. The salt water, which came downwind against the turbine of the sea and at land conditions are right, the fuel flow up with changes and operation shows toward the engine intakes. The engines leave these parties along with the air.

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water. No water has through the flapping procedure was made some salt remained in addition to the engine, and reduced the corrosion.

It is noted blade getting in some cases severe enough to cause the closed engine to run rough because of air flow. The engine was replaced with a new one. They were lubricated with Fluorinert, a synthetic grease, and overhauled in service.

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• Compression casing, rotor, vane, and blades now are made from AM 355, an Aluminum-Lithium casting steel.

• Combs are being coated

with an electrodeless nickel plate.

• No. 4 bearing housing now is fabricated from Inconel V material.

• Spline-chamber paint continues in use on the power turbine.

• Electroless nickel plating protects the compressor vanes.

• Blade and vane shape on the compressor inlet and stage carry features for solid prevention.

In addition to three major fixes, GE had developed a set of engine procedures for overhaul parts and had designed the overhaul facility which can be reached before engine shift, life and performance is affected.

There have been a series of small and random troubles of the kind that have bedeviled every engine and its maintenance during the service of the powerplant.

Rapid fuel and air flow control is needed, that turbine vanes fixed by changing to flexible lines.

Combs were looked, but the blades were stopped by quality control improvements and process changes.

Fuel contamination was reported going inside in the engine, GE said.

T58 Growth Version Features

West Lynn, Mass.—Airline and turbine rotor development increases plus a major redesign of some parts are features of the General Electric T58-GE-10 growth version of the T58 turboshaft powerplant.

New model is rated at 1,450 shp, 200 more than the greatest version of the 4-variant. Power growth is accomplished without major changes in turbine dimensions as power weight ratio.

The T58-GE-10 engines have been built and run, with more than 1,250 hr of test time logged since February of last year. High test engine has been run for more than 300 hr at maximum military power and has a total time of test time 415 hr. Starting at the front of the engine, GE designers changed the first-stage inlet vanes to enable the engine to pump more air. Feathering the engine vanes was improved, and the compressor generally was changed up conditionally to reflect the possible drive.

Power turbine inlet temperature was raised, but only by 10F to a value of 1,710F. Air intake at the turbine temperature and was reduced. Engine weight was increased by 30 lb during the redesign, but the power weight ratio remains the same.

New fuel control system is being developed for the 10 engine to improve load during in-flight operations and to improve the over-temperature indication for the pilot.

This new system is electric, and uses the power output of the engine to measure the power turbine exhaust temperature and the turbine speed. It compares the readings from the engine to the turbine speed, and a temperature indication. Tapping of this engine is done with a T-10, a feedback control based on sensing the power turbine exhaust temperature and, if there is an over-temperature indication, cutting back the fuel flow immediately.

Collective input signal from the helicopter pilot is also used as a factor in reducing fuel flow. The rate of change of the collective input will be used to make sure that the change in power will not reduce speed which the collective change demands.

Consequently, the pressure of the fuel system is much better, and there is more of the power drop that occurs without this feature.

GE engineers on the collective input signal provide accurate performance monitoring.

Company says that 30 engines without the new fuel control system could be delivered in December this year. Engines with the fuel control system are scheduled to complete Navy qualification tests in September, 1964. Navy is feeling the development program.

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Sud Aviation Super Frelon Details Shown

First prototype of Sud Aviation's SA 321H Super Frelon (above) has logged over 50 hours in actual test flight last December (AW Dec. 27, p. 36). Helicopter is powered by three Turbomeca Turmo MC gas turbines. Second prototype is scheduled to fly only next month.

Six-bladed rotor hub (left) and tail rotor are conventional Sikorsky design, based on the S-61. Rotor diameter is 62 ft. Note two engine exhaust ports below rotor. Third engine exhaust port is on opposite side.

Front view (below left) shows landing gear design and new cargo door ramp. SA 321H main rotor is 25 ft long, 6.2 ft wide and 5 ft high.

Side view (below right) shows third exhaust port (third rotor door and heat sink). French government has ordered two prototypes and four preproduction models.



SPACE TECHNOLOGY



OVER-ALL AERIAL VIEW of Aerojet General's new Miami Silo plant shows the main-made islands built up in swamp land immediately adjacent to Everglades National Park. Facility site has been made from solid, a concrete rock, dug from the ground. Land is so swamp that water gradually fills an excavation, making islands adjacent to each other and later where rock has been excavated for foundations. Test stands (not visible in this picture) will be located off roadway leading off to lower right corner of the photograph.

Aerojet's Miami Facility Nears Completion

By George Alexander

Miami—Aerojet General Corp.'s solid propellant plant here is expected to be completed by Oct. 30 and in operation by Nov. 30, 1967, leaving the company about 11 months to build a 160-in.-dia rocket motor.

Aerojet was selected recently (AW Apr. 15, p. 38) by the Air Force and National Aeronautics and Space Administration as a parallel contractor with Thokol Chemical Corp. for package I in the large solid motor feasibility demonstration program. (AW Feb. 11, p. 33) The contract calls for testing the first of two motors within 35 months.

Construction of Aerojet's new plant, 15 mi south and slightly west of Miami, was begun last December. The company decided early last year to build a new plant in a large-scale (yet remote) The decision, according to Elmer Nelson, plant manager, was made without consideration of the large solid motor program. Approximately 14 sites were investigated in the first. West and Gold counts of the U.S. before this area was selected.

Aerojet has spent about \$2.5 million to date in acquisition and lease of about one-fourth of the plant site's eventual 74,331 acres. The balance of the land is expected to cost about an additional \$6.5 million.

Approximately 54 million has been spent so far in site preparation, excavation and pre-construction of construction items. When completed, the plant is expected to cost about \$10.8 million exclusive of land costs. It will be paid for by federal and corporate funds.

Structures are being erected presently for the plant's 10 major facilities: inert processing, fuel preparation, oxidant preparation, quality control laboratory, construction area, fueling, storage and training, cut and cure, environmental

test center, 500,000-lb thrust static test stand and a combined cut, cure and static test stand.

The company plans to use this test facility for 200-in.-dia motor only. The smaller test stand will be used for sub-scale versions of these motors.

All inert parts of a motor, such as the case, nozzle, propellant and chamber, will be inspected and tested for further operations in the inert processing facility.

In the fuel and oxidant preparation buildings, the raw elements of the solid propellant will be prepared and blended separately, in anticipation of mixing in the continuous mix facility. In the 5,000-gal. fuel preparation building, polybutadiene, plasticizer and curing agent will be blended together in a liquid process. Aluminum particles—measuring .35 micron—will then be added to the blend.

The facility will be able to produce up to 2,400 lb of fuel per hour and like all facilities at the plant, is being designed for use with any solid-propellant composition.

In the 5,000-gal. oxidant preparation building ammonium perchlorate—the oxidant specified in the contract—will be received for storage. Delivered in 50-gal drums, the perchlorate particles will be baled to remove any moisture absorbed during shipment and then ground to varying sizes dependent upon the burning rate and desired specific impulse for the propellant mix.

The particles, as delivered, are about the size of grains of table salt; they will be ground down to give varying sizes from fine to coarse. Generally, the finer the grain, the faster the burning rate and the higher the specific impulse will be.

After grinding, an oxidant blend will be composed of different particle sizes, screened and weighed. Capacity of this facility will be up to 5,000 lb per hour.

Liquid fuel, in 1,000-lb-capacity metal canisters and powder oxidizer, in 5,000-lb-capacity hoppers, will be moved from this preparation buildings into the continuous mix facility.

Key element of the Aerojet plant will be the 11,000-gal. mix facility. Above will be a 30-in. Proctor-Baker mill will contain about 150 lb of propellant any given moment during a mix operation.

The small amount of propellant in the mixer will ensure maximum blend change to the facility in the event of an accident.

A duplicate mixer, plus associated equipment, will be kept in storage at the plant so that if the first unit is destroyed, the second could be switched



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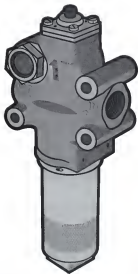
ing guidance system, the bomb/launcher, the entire ground support system—helped achieve the prime objective: make the entire system mobile and air transportable.

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porter-launcher for its proposed **MMBIM**—Medium Range Ballistic Missile.

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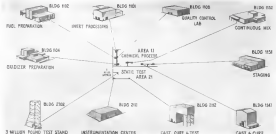


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ARTIST'S DRAWING of Alameda General's new Mixed plant shows layout of solid propellant facilities. Test stands and expected configurations of plant buildings. The 3M is the motor used to static test in the 3 million lb. thrust test stand, 200-in. dia. motor would be housed and then test stand in the overhead cast, cure and test facility.

and the plant put back in operation within three weeks.

Fuel will be received from its trailer cars into a 1,000-gal capacity tank at the mix facility and pumped in measured amounts into the mixer. The oxidizer will be dumped into bins at the facility and received on a conveyor belt into a gravity-type feeder.

The screw will inject the oxidizer into the mixer.

Propellant Mixer

Within the mixer, blades will simultaneously mix both fuel and oxidizer and push the non-combustible mixture toward the outlet of the equipment. At the outlet, temperature-controlled hoppers, each with a 5,000-lb. capacity, will collect the propellant and haul it to the cast and cure building. Production range of the mix facility will be between 2,000 and 6,000 lb. of propellant per hour.

The 3,600-sq.-ft. cast and cure building will contain five pre-stress capable of occupying ration with diameters up to 175 in. and lengths up to 33 ft. and two capable of accommodating motors up to 60-in.-dia. and lengths up to 33 ft.

A motor case would be deposited in a pit, the case encased and positioned, and then propellant pressure fed into the case with a bypass-type feeder.

Motor Inspection

After curing—estimated to require about two weeks for curing of this size—the cast would be removed from

the pit, inspected and X-rayed and then moved on a horizontal dolly to an 8,500-sq.-ft. staging facility. Then, the piece will be transferred and cut back to the desired configuration, the air cleaned, primed and ready to stage and the motor prepared for firing.

Cast, cure and static test facilities for the 200-in. dia. motor will be a 100-ft.-tall, 60 x 60-ft. steel-reinforced concrete building, with a 150-ton-capacity derrick crane on top. A 100-ft. tall 40 x 10-ft. steel linear tower will stand adjacent to the building. In the 33-ft. wide slot between tower and building will be the static test stand. The 65-ft.

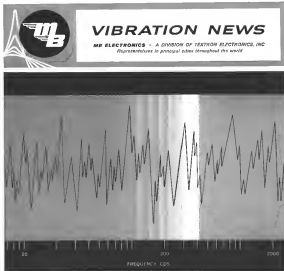
tall, 160-in.-dia. motor will be located to a vertical position in the derrick crane, and lowered onto the stand, which also serves as a support structure during loading operations.

A 30-ft. tall, 30 x 40-ft. steel skidder dies will be positioned to the crane over the top of the motor case to provide environmental control during propellant loading. Propellant, received from the mix facility in 5,000-lb.-capacity hoppers, will be tracked to the building, moved by elevator to the top level within the structure and then lowered into the case.

After curing, estimated to last about six weeks for the 200-in.-dia. motor,



STATIC TEST STAND for 175-in. dia. motor will be able to take up to 3 million lb. thrust. Motor case to encase motor vertically in locomotive. Cast/cure building for the stand has been laid, steel tower will be built up within next several months.



MB introduces SWEEP RANDOM— a new, low-cost method of random vibration testing

MB Electronics now offers industry the Narrow Band SWEEP RANDOM system. This new technique in random vibration testing is designed to create stresses and accelerations at all levels similar to those provided in the more expensive wide band random test. It is easy to operate and inexpensive enough to be used with the smallest simulation test system in general use today.

The new MB SWEEP RANDOM method reduces the total force required for wide band testing by sweeping slowly over the frequency range with an intense narrow band excitation, in contrast to the low acceleration density excitation of the wide band test. This results in a reduction of from one third to one half the force ratings heretofore required for simulated random vibration tests. Considerable cost savings are also realized with this new MB system.

The MB SWEEP RANDOM system is ideally suited for testing components and sub-assemblies of systems which might be given a final qualification test by wide band random techniques. For more detailed information on the SWEEP RANDOM system write to MB Electronics, The Whalley Ave., New Haven 6, Conn.

its shifter will be removed by the crane and the aft closure, nozzle and pyrotest installed. Up to 273 instrumentation leads then will be connected to the water, which then will be ready for firing.

Stand is being designed to accept as much as 7.5-ton load. In thrust, with the water positioned vertically, its weight toward the sky.

Test stand for system with diameter up to 175 in. will be able to accommodate water in vertical or horizontal position and thrust up to 7 million lb. About 247 channels of information will be taken off this stand. All data from both stands will be carried on land lines to an instrumentation center about 2,500 ft behind the nozzle stand. This center may consist only of a series of mobile vans.

The 10 buildings are being built on mainwale stands on a ramp lead adjacent to Douglas Nitrogen Park and are interconnected by conduits. The buildings occupy about 300 acres within a 700-acre site and will be able to

hold up to 130,000 lb. of Class 9 explosive propellants at each facility.

Acrop's also is planning a series of 80-ft-wide, 13-ft-deep ponds to store water. The buildings, as the latter water can be each moved by barge. Crotch on Acrop's land will connect with a series of flood control waterways either directly in contact or being built by the Central and Southern Florida Flood Control District.

Major flood entry would open up to Banana Stand at the southern end of Broward Bay and would provide access to the intercanal waterways. Distance between the Banana Stand outlet and the nearest corner of Acrop's property is about three miles.

Acrop's land consists of two areas, a 25,196-acre southern and a 45,401-acre northern outgrowth, spread by a two-mile-wide, 5.75-acre culvert. The solid propellant plant will be located in the southern area. There are no manufacturing plans for the northern area although the company might use it for some testing of large liquid engines.



Republic Tests Apollo Space Suit

Apollo space suit is being tested in Republic Aviation engine in conjunction with a special Nike Test designed to measure engine consumption and metabolic rate. Suit will be developed by International Latex Corp. Republic is investigating and making, usability, and physiological factors involved in the lunar program.

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aerodynamic engineers.
Republic Aviation Corp.,
Farmersdale, L.I., N.Y.

New Data Pinpoints Micrometeorite Size

Washington—Space vehicle sensors indicate that about 100 tons of cosmic dust falls on the earth each day, and scientists are now able to estimate the dust particle size with a precision up to 100,000 times greater than was possible before space measurements.

At the recent American Geophysical Union meeting here, Dr. F. L. Whipple of the Smithsonian Astrophysical Observatory and a coalition of considerable measurement of micrometeorites, particles made from ground observations, balloons, probes and satellites has provided new data on both size and density of micrometeorites. Through these means, he said, it has been possible to determine that the size of the micrometeorites ranges from 10⁻³ grams to one gram, with densities from five to 10⁻⁵ g/cm³.

The cosmic dust is thought to originate from the cosmic cloud when meteorites collide, Whipple said. This information, called the Whipple-Roberts effect, is the spreading inward of particles which come in contact with the earth's atmosphere.

Dr. Whipple said cosmic dust apparently presents no serious hazard to spacecraft except when close to earth. This conclusion, established by ground

observations, was confirmed by the Mariner 2 Venus probe.

C. W. McCroskey of Goddard Space Flight Center reported that meteorite flux peaks and falls at a diurnal frequency of the lower cycle peak pulse recorded during the full moon. He said that significant background noise in meteorite data obtained by satellites results in weak flux phenomena, but that recent readings by U.S. space vehicles, along with Canadian and Australian observations, substantiate this effect.

Probable the regular meteorite flux cycle will affect scheduling of long duration manned space flight.

Dr. Donald B. Guilt of Ames Research Center, as a result of laboratory studies of high-velocity impacts of particles in rock and sand, showed that meteorite collisions with the lunar surface produce craters that subside as the earth's dust cloud.

Growing interest in the lunar surface has resulted in another AGU session, which demonstrated that there is no consensus as to whether the moon's surface is covered with fine dust or whether it is covered with a more substantial substance.

Dr. Charles R. Warren of the U.S. Geological Survey feels that if the

strong backscatter of light from the moon is caused by surface roughness, the surface material must have a skeletal structure. Sublimated volcanic soils, etched by the solar wind, would possess most of the lunar optical, heat and electrical properties observed on the moon he said.

Dr. B. W. Hagile of the Center for Radiophysics and Space Research, Cornell University, concluded that the optical haze reflecting of the moon indicates that the surface is covered by a blanket of microscopic rock dust.

Dr. R. S. McCall, of the Defense Research Administration of the Defense Department, believes that the moon is covered with a porous, slag-like substance. In a recent Radio Moscow broadcast, he explained that because the moon has no atmosphere, each meteorite impact causes dust particles that bombard the lunar surface cause an explosion which results in rock boiling and becoming slag, porous slag.

Because the characteristics of the lunar surface have been determined before the first explorations, missions are begun. National Aeronautics and Space Administration has given Boeing, Systems Div., a 10-mk., \$27,500 contract to study two possible lunar surface

materials to help guide the design requirements of a lunar landing vehicle.

Boeing will study three pairs of data and three densities of particle under both atmospheric and vacuum conditions.

Mariner 2 experiments reported heretofore by the Venusian spacecraft have previously reported (AV May 4, p. 30), and the growing amount of information on the planet has applied to planetary based measurements and the use of Mars Mars data.

Dr. Bruce C. Mason of California Institute of Technology said that in a result of observations with the 700-in

Gemini Ejector Sled Tests Set

Burlingame, Calif.—Ejector test escape system for Gemini spacecraft will be used in the next sled ejection test phase of development at Naval Ordnance Test Station, China Lake, Calif., in June.

Sled tests will prove the ejector system capabilities for Gemini escape ejection on a target which the spacecraft is being lowered by parajules.

Ejection tests from a 15-ft high tower at the test station are now being completed and have included the formation of on-landing ejection, according to White Aircraft Corp., developer of the escape system. First production model of the system test is scheduled for delivery to McDonnell Aircraft Corp. in December.

Use of ejection tests for crew escape was considered necessary for test, was cut from the spacecraft during recovery with the parajules system in the event of an emergency. The escape system which isolates the entire spacecraft close of the booster is used on Mercury and is planned for the Apollo spacecraft.

Gemini escape system is designed to eject both seats at the critical moment when cosmic dusts in the recovery region located between the legs. Ejection of both seats, released from each other at an angle of 24 deg, occurs after initiation on the side of the spacecraft is opened by explosive squibs and locked into position. The ejection seat firing is timed in a container during orbit to prevent inadvertent firing.

Seat is opened from the spacecraft by an explosive charge, which catapults the seat along two 45-in.-long rails. Rocket Power, Inc., Miss., Ark., is developing the catapult-launcher system. Thrust is worked up 45 deg and the seat rocket booster which ignites 0.2 sec after seat is actually leaving the seat rocket propulsion angle to 40 deg above the horizon.

Peak accelerations of 2½ g results from the catapult change with 100 g rate of ejection. Total 10 g acceleration in the seat is 1,300 ft/sec-sec or a 0.27-sec

burning time. The emergency ejection system (AV Feb. 25, p. 99), NASA requires that ejection land at a 100-ft maximum target distance from the 100-ft booster. Range error is 100 ft. Time from ejection to zero at China Lake and White Aircraft Corp. test ejection system of 800 ft or better is possible. Typical maximum trajectory altitudes here have been about 450 ft.

Each astronaut is fitted individually to the ejection seat, including the helmet and head restraint, oxygen and oxygen tank (not part of the ejection seat, oxygen supply). The ejection seat separates the astronaut and his backboard and upon lift from the ejection seat. The backboard, which probably will be constructed of hard foam material covered with glass fibers at a 100-psi, in parajules jacking, containing a 25 ft sheet and a survival kit package attached between it and seat framework. The seat and oxygen tank will be constructed entirely of glass fibers.

No critical seat alignment mechanism is incorporated into the system, so that the eye level of different size astronauts is kept at the same point by varying the thickness of the oxygen tank seat.

Astronauts will wear head plates, fixed to the seat during lift-off and descent, restraining leg movement except up and down. Head plates rather than oxygen are necessary since astronauts will be wearing soft shoes for comfort on extended Gemini flights.

White Aircraft Corp. is developing the catapult-launcher system. Thrust is worked up 45 deg and the seat rocket booster which ignites 0.2 sec after seat is actually leaving the seat rocket propulsion angle to 40 deg above the horizon.

Peak accelerations of 2½ g results from the catapult change with 100 g rate of ejection. Total 10 g acceleration in the seat is 1,300 ft/sec-sec or a 0.27-sec

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NEW TENSION LATCH



PROBLEMATIC RECREATIONS 168



Assuming the day (1961) is 1961, with 31 000 p.m., and more at a uniform rate, how can a lost boy scout determine speed by means of a watch on a cloudless day?

—Contributed

Digitalization and study of systems integration problems is one of the majoring assignments at the Data Systems Division for Systems Engineers with five years' experience in digital data processing systems. Specific areas include technical data systems, name tracking, medical computer interface, digital communications, and mixed mode navigation systems. Qualified applicants are invited to send a résumé to Mr. T. Lyle Lampson.

ANSWER TO LAST WEEK'S PROBLEM 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

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Space required for submarine's postage cables was reduced from 3,000 sq. in. to only 450 sq. in. when this FLEXPRINT cable replaced a conventional cable approximately 1" in diameter. Total weight of the assembly was reduced from 125 lbs. to just 30 lbs. and the FLEXPRINT cable weighs approximately 3 lbs. as compared to 11 lbs. for the ordinary cable. This FLEXPRINT cable consists of conductors, a 3" wide and 60" long.

Packaging problem for odd channel multi-pair cables couldn't have been solved without this FLEXPRINT RETRAX cable. Measuring only 2" in diameter it is made to order 60' when the reversible channel is pulled out - rolls on itself when released and returns to its original formed shape. In life testing, this FLEXPRINT RETRAX cable exceeded the customer specified 100,000 cycles with no apparent change in any part of the cable.

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FLEXPRINT® flexible printed circuitry makes an engineered component out of wires! This means you can take entirely new directions in the design of new equipment... create packaging innovations never before possible. Or... replace the individual wires in your present electrical and electronic assemblies with a single engineered component.

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FLEXPRINT circuitry is protected by extensive patents, issued and pending in the U.S. and abroad. Sanders Associates, Inc.



CREATING NEW DIRECTIONS IN ELECTRONICS



West Germans End Sergeant Training

West German troops (above) prepare to launch American Sergeant Guided missile from White Sands Missile Range, N.M. Two of the solid propellant 4-in. range missiles were launched (photo at right) as part of practicing exercises for one of West German Army's 190th Field Artillery group training at Ft. Sill, Okla. At bottom left, Sergeant launch crew completes missile checkout prior to automatic countdown and launch on the launch at Sea Nevada Island. At bottom right, Pt. Mugu during a series of three launches at the Pacific Missile Range. At bottom right, one of the missiles is shown being launched to target.



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It's comforting to know that Honeywell is doing your looking for you. Comforting to know that your instruments are backed by the stature, skill and experience of Honeywell, a leader in the aircraft and aerospace instrument field. Over the years, we have pioneered many advanced aircraft instruments and mechanisms to meet the most baffling demands of weight,



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Each mechanism was custom designed to solve a particular spacecraft problem. Honeywell versatility is suggested by the variety of mechanisms illustrated... ranging from subminiature sealed relays to the many elaborate bar indicators. The unusual flexibility of Honeywell's plant facilities permits rapid design, testing and manufacture of specialized work. Whether you want a miniature mechanism or a complete system, Honeywell can help you. Write Honeywell, Precision Motor Div., Greiner Field, Manchester, New Hampshire.

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NEW AEROSPACE PRODUCTS

Jet Inlet Control

Fluidic pneumatic/hydraulic system, called Nudason Model DPC-1, is specifically designed to control jet engine valve passages of supersonic aircraft.

Unit comprises pressure ratios by sensing inlet air pressure and static pressure in the inlet duct. System then regulates hydraulic pressure to control the inlet ring or spike. Turbine bleed air, bleed and regulated, powers the



system. The bleed air becomes a variable force acting upon two opposing pneumatically linked displacers which act as a pneumatic servo motor controlled by the differential pilot system. Shift and force balance system may be preset at static to ram air ratios of 0.2 to 5.0.

Unit is usually set at a ratio of .67, the null position for the hydraulic valve. At ± 5 gpm flow at 1,000 gpm hydraulic pressure is achieved when the ratio is run at static air changed by ± 5 . Model DPC-1 is 2 1/2 in. x 2 1/2 in. x 7 1/2 in. and weighs less than 3 lb.

Shelly Associates, Inc., 111 Emoryton Drive, St. Joseph, Calif.

Miniature Tach Generator

Miniature tachometer for driving aircraft engine speed indicators and other individual units, halves the cost and weight of similar mechanisms, the manufacturer says.

Unit measures 2 in. x 2 1/2 in. and weighs 12 lb.

Kohman Motor Corp., Dekalb, Pa.

Heat Flow Meter

Heat flow meter called "Q" gage is designed to accurately measure heat flux at precise locations within objects, such as nose cones, rocket nozzles, ablating structures and other components where the transfer of heat energy is of interest.

Meters must be oriented from the manufacturer in the same material so that being tested to eliminate possibility caused by heat flow through dissimilar materials. "Q" gage is supplied in graphic, stainless steel, plastic

lamination and other materials upon request. Thermocouples within the "Q" gage are held to a minimum and combined in a thermopile to yield available compensation from ambient low temperature differences.

Science Products Corp., Rt. 46, Dover, N. J.

Instrument Dehydrator

Aircraft instrument dehydrator is merely inserted from the instrument area and vents it into the atmosphere.

Available in two models, DD-15 and MK-4, (DD-15 shown) the units are identical in operation but different in configuration. Units are serviced by



correct changes in air pressure, however, they maintain pressure equilibrium during altitude changes thus preventing a dangerous pressure buildup, the manufacturer says. Unit weighs less than 1 lb.

Devo Instrument Co., Tilbury and Foster St., Roskilde, Denmark.

Vibration Equalizer

Random motion spectrum equalizer is designed to add natural random noise whenever test capability to an existing controlled vibration test facility.

Equalization of, or compensation for, vibration table and specimen resonance is accomplished through a parallel bank of 16 individually equalized magnetoresistive films. Signal level throughout after is controlled by a separate logarithmically scaled attenuator. Each channel of the bank of 16 films has a bandwidth of 23 cps. The equalizer handles over the band from 20 to 2,000 cps but has a switching facility which permits selection of equalizer bands at high as 10,000 cps.

System is capable of manual adjustment and measurement of the vibration reference level for each film individually thereby eliminating the need for complex auxiliary spectrum analyzer equipment.

Neo Geo Aeronautics, Alexandria, Va.

All-Weather Landing Proposals Requested

By Philip J. Klaus

Washington—Major jet transport manufacturers and autopilot manufacturers will submit proposals this week to the Federal Aviation Agency for the design and installation of an all-weather landing system on a transport aircraft intended to be a prototype of one which can be retrofitted on the nation's transport fleet. FAA hopes to evaluate the system in flight tests within two years.

All-weather landing, a concept now adopted by FAA as a basic element of an airborne sensor, electronic and computer to generate three-dimensional and automatic flight control for pilots. These basic techniques as predicted by AVIATION WEEK & SPACE TECHNOLOGY are the ones employed in the British BLISS airborne landing system (Jan. 14, p. 74).

Details in FAA's proposed configura-

tion and all-weather program will be disclosed this week at the 15th Annual International Air Transport Association technical conference on all-weather landing, which is being held in Lucerne, Switzerland. The report will be given by A. D. Wink of FAA's system design team.

The IATA conference also will hear reports from Airborne Instruments Laboratory and GECAS on their Planescan and Regal airborne landing system which FAA proposes to pass over for early implementation. The agency acknowledges that such systems may have a role for the next decade as an intermediate member or backup for the radio altimeter (flare-out) system.

This is a decision which Airborne Instruments Laboratory spokesmen are expected to contest in their IATA reports later here.

Bidders for the FAA prototype all-weather jet transport program contract will include teams of Boeing-Boeing (Edgemoor, Penn.) and Douglas-Sony, each, the airborne navigational systems in prime contractors. Lear Siegler is planning to bid, perhaps in a partnership with General Dynamics Corp. or Collins Radio, a firm not bid but seen as participating in the program with its flight director instrument. North American Aviation Inc. has been invited to bid but its attention may be diverted to other projects.

Program work statement issued by FAA to prospective bidders stipulates that the winning contractor must be recognized source of competence in the all-weather landing field to achieve the desired result in the shortest possible time without duplicating existing development. The contract, FAA's belief that the required hardware is available and needs only to be integrated into a variable system.

System is to be installed on an FAA "OT" (test) aircraft. The first product is to serve "as a model to the industry, which may be copied in other aircraft," the work statement says. A primary consideration is the design is that it be reliable and conceptually feasible for retrofit of aircraft's operational aircraft and provide required performance and operational safety.

In addition to designing the airborne sensor and installing it as a jet transport for subsequent FAA evaluation tests, the contractor selected will voluntarily conduct an extensive program of analysis and simulation using both discrete analog computers and an-



Antenna Modeling Technique Reduces Computations

Flare-out antenna modeling technique—developed by Research Div. of Electronic Communications, Inc., to reduce complexity of three-dimensional computations required and to minimize need for full-scale model—was used to model a flare-out antenna in a photograph in copied-duplicate form. When antenna mounted on an airframe of the flare-out antenna is similar to that obtained from full-scale model. The flare-out antenna when operated at frequency of 70 mc (dec) simulates performance of a 3941 antenna at 3.2 mc. Antenna model (right) had with accurate modeling antenna to reduce multiple reflections. It was in test phase—model. The flare-out antenna, constructed as two separate, sets on antenna plate connected to pattern recording equipment. The RF source and transmitter were set up at the end of the tunnel. Receiving equipment to measure voltage is located near distance away in a corner. Facility is located at ECI Research Div. in Glenview, Ill.

clude flight simulators. These are to be used to develop crew operating procedures both for normal and emergency conditions, to determine crew response to failure states, and to evaluate ability of pilot to maintain control of aircraft in emergency, for example.

The FAA system modifications calls for a fully automatic system about the aircraft plan a final modification of flight direction and other visual displays to provide the pilot copious with the means for controlling the performance of the automatic system and for taking over and making a manual landing in event of malfunctions in the automatic system. In this report, FAA's own figures differ from British thinking which favors use of three independent automatic flight control systems (triples redundancy) on each engine.

Prototype system will have provisions for both three-engine and split-engine for both terrain operation. The latter option allows terrain plots to normally extend southward from the autopilot control radar and sensors. Both sensors and actual flight tests will be used to evaluate the desirability of split-engine operation for that mode.

Flight control system will have three modes of operation, corresponding to different phases of the instrument approach and flare-out.

• **Glides path extension**, moving approach from initial acquisition of ILS location to a point where the aircraft passes over the middle marker beacon. At middle marker, the aircraft's altitude is approximately 100 ft.

• **Glides path extension**, from the middle marker until the aircraft reaches a flare-out maneuver in an altitude of approximately 70 ft.

• **Flare-out mode**, from the initiation of the maneuver until touchdown.

Glides path mode of operation closely resembles the present autopilot-coupled ILS approach, except for improved pattern of the airborne equipment and the ground-based ILS antenna designed to the all-weather Category I standards adopted by the International Civil Aviation Organization.

Glides path extension mode is designed to serve as a backup to the middle marker (100-ft altitude) using an airborne vertical clearance meter (VVS) to monitor one or two angles in the glides path from until flare-out altitude is reached. Then glide slope monitoring (flare-out) technique has been successfully demonstrated by the British in their BLISS system and in other U.S. airport installations.

Flight control system will have three modes of operation, corresponding to different phases of the instrument approach and flare-out.

Flare-out mode will begin when radio altimeter indicates the aircraft has reached required altitude. In the flare-out mode, the flare-out altitude value will be adjustable to enable the FAA to try a range of values. The system also must provide means for monitoring airframe prior to touchdown so that the result will be directly aligned to the runway.

If a third mode were to be added, the flare-out mode is to provide the flight crew with displays which show the optimum flare-out path attitude for safe recovery at the particular altitude at which the flare-out occurs.

Automatic flare-out control is to be designed to maintain the aircraft at altitude except throughout the approach until touchdown. Despite changes in aircraft configuration, it is given necessary to shut down one or more engines, the system must enable the pilot to return appropriately to the flare-out attitude while the operating engine thrusts automatically adjust to maintain speed.

Throttling control is to be of two independent subsystems, one operating the two independent engines and the other the two thrust reversers.

FAA has set up the following performance objectives for the system which had, expressed in terms of aircraft velocity or position with respect to runway at touchdown. The objectives are to be accomplished in the presence of up to a 25 ft headwind or tailwind and crosswind up to 25 kt, in steady state conditions.

• Vertical velocity is to be controlled to

Too Many All-Weather Solutions

Washington—International Air Transport Association all-weather landing and take-off conference in Lucerne, Switzerland last week will be exposed to another example of the fact that operational advances in navigation, traffic control and all-weather landing are not expected by lack of suitable technical solution but by the availability of too many.

Spokesmen aware because of the public nature of the American aviation industry, its willingness to accept corporate funds in new ideas and competitive sponsorship by different government agencies.

Reports delivered by representatives of Airborne Instruments Laboratory at Lucerne will state they are with the FAA's decision to adopt its airborne radio altimeter for guaranteeing the flare-out maneuver in preference to the U.S. own ground-based system (AW July 17, 1961, p. 49). The report by GECAS Corp., describing results of FAA tests on its competing Regal ground-based system, will not discuss question the FAA's decision (AW May 16, 1969, p. 137).

The AIL position is that the use of an airborne radio altimeter requires two methods of terrain detection in front of the runway at the same altitude as the survey. The AIL report will report the results of its survey of U.S. airports which suggest that many lack suitable or sufficient runway extension for altimeter use. The FAA's position is that of 23 airports U.S. airports which are likely to require all-weather landing capability during the present decade, only one or two remain after problems to the altimeter approach.

The AIL report also will be critical of the use of the radio altimeter because it requires flare-out at a lower altitude (due to runway extension limitations) which thus causes greater hazard if a missed approach must be executed.

Additionally, AIL spokesmen will stress the complexity of an airplane using the radio altimeter landing system to "flout" as the presence of a jet wind, leading to an increase in the runway for a side step. The FAA view is that a "flout" headwind problem system with a "flout" problem, even evidence under the same system because the aircraft must make path maneuvers at low altitude to land at prescribed point.

Agency's spokesmen will state results of flight tests conducted by Edgemoor-Boeing (now a B-71) at FAA's National Aviation Facilities Experimental Center at which eight out of 19 attempted altimeter landings with Planescan had to be aborted under gray conditions. To counter this, AIL is expected to cite the experience of the French government as both on Planescan using a Caudron.

FAA spokesmen acknowledge that there may be a requirement for a ground-based type altimeter landing system during the 1970-80 time period either to maintain the radio altimeter system or to serve as the primary system where an all-weather system is required for several hundred U.S. airports. They add that the operational availability of such a system is at least seven years and that it should resemble the best features of Planescan and Regal without their present limitations.

An AIL spokesman says that Planescan can be implemented easily in equity as the radio altimeter system, pointing out that the company has developed an all-weather altimeter system and has produced a ground-based ground equipment. He adds that AIL has suggested to FAA that a Planescan receiver be installed in the jet transport which the agency plans to install with the radio altimeter system for side-to-side tests, but that FAA has not adopted the suggestion.



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3. **Drives** a detonation around corners in delicate circumstances with Du Pont Mold Detonating Fuse—the cord with the completely standard explosive core.
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5. **Regulates** a lightning, or sequence component, with Du Pont electronic input or detonators—available with a wide variety of performance characteristics.
6. **Triggers** and transmits an ignition, so with this primer assembly, used to ignite the rocket of a new jet-fighter weapon.

7. **Spreads** a controlled shock wave over a large surface, with flexibility about explosive—"Discoat". You can cut it with a knife to any shape or dimension—area "blotter" in area of many square yards. Among its uses: fortification and mining of metals.
8. **Feeds** a rocket or missile with propellant made from one of the many Du Pont propellant chemicals, from small particle micro-actuators to intercontinental missiles.

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SYSTEM ANALYSIS



ENGINEERING DESIGN



FABRICATION



TEST



FIELD SERVICE

3 fpm, ± 1 fpm anemograph deviation. (The anemograph deviation a statistical expression means that out of 100 readings, 68 of these must not exceed several standard deviations and between 1 fpm and 5 fpm at the anemograph's readout.)

• **Touchdown point** along the length of the runway is to be within 250 ft of the ideal point on a one-stage taxi, and the runway is to be within 10 ft of the runway centerline.

• **Cross angle** (difference between aircraft and runway heading) at touchdown is not to exceed 1 deg. on a one-stage taxi.

FAA is calling for the software system to include built-in self-test provisions when necessary to permit flight crew to check system performance prior to an instrument approach.

SYSTEM FILTER CENTER

• **Computer Literature Database**—Use of computers for document retrieval "would empower the user under a flood of information and miscommunication it would produce," according to Dr. John R. Pette, executive director of research and communications programs/systems division of Bell Telephone Laboratories. Pette, one of the first to suggest the feasibility of communications satellites and a science fiction writer on the side, made the comment at a conference dedicating new John Center Library at Illinois Institute of Technology. While acknowledging the value of computers for library indexing, Pette said that, "If I have pointed a rubber glove picture of the relation of computers to libraries, I have done so deliberately... to contrast the rubber glove picture that has been painted by some impractical people."

• **Sensorimotor Fusion Theory**—Staff use of galvanic-inert metal electrodes may be due to motion of carbon ions within the brain of rats, according to research program for Biologic University Research Institute aimed at better understanding of basic life and degeneration mechanisms. Details on the program, sponsored by Air Force, are available in HSC-50 report, identified AD 285-210 ("Fluorocarbon and Experiments of Studies Relating to Mechanisms of Fusion of Sensorimotor Devices") for \$1.00 from Office of Technical Services, Committee Dept., Washington 25, D.C.

• **Mini Laser Cym Emission**—General Precision Aerospace, Kierulff Dr., has experimental development model way in laser system, first demonstrated by Space Gyroscopic Co. (AIAA Feb 11, p. 98)

The General Precision optical gyro also three get laser in a triangular configuration rather than four in a square configuration employed in Sperry.

• **Microarray Tube Lenses Proposed**—Program under which the electron lenses would have necessary tubes from manufacturers who would also be responsible for field maintenance and repair has been proposed in Worcester Electron Tubes, Inc., Des Plaines, Ill. Under the proposed plan, Worcester would be responsible for carrying out proposed tube procedures. The lensing concept is used by Electron tubes which rubs microarray tubes from French manufacturers companies.

• **TV Tube Extends Telescope Range**—An image orthicon recently added to Northern University Division Observatory's 18-in. reflecting telescope has given it a light-gathering power equal to a telescope 180 times its size. A telescope equipped with an image orthicon can be able to use a strong blue star up to infrared viewing on the moon. Northern University scientists believe. The 18-in. telescope with image orthicon is able to record star surface features less than 1 km across.

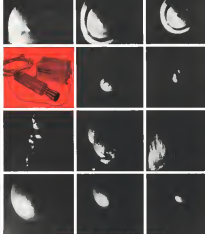
• **Microarray Component Sales Report**—Factor sales of microarray components by U.S. manufacturers totaled \$75 million according to Electronic Industries Assn. The figure is extrapolated from reports in 54 manufacturers, comprising an estimated 90% of the industry's total volume.

• **Signed on the Dotted Line**—Major contract awards recently announced by private manufacturers include the following:

• **North American's Antibodies Division** will conduct feasibility study of a complete antibody, all-weather aircraft approach and landing system which requires no ground based radio/tower and no crew. Initial contract awarded by National Aeronautics and Space Administration's Aeronautics Research Center. Such a system might be useful for V-22/V-26, variant of military aircraft operating out of forward base landing strips.

• **Electronic Communications, Inc.**, Research Dr., Tannam, Md. will study a design for superconducting magnet operating at frequencies above 100 GHz (low) under \$85,000 contract from NASA.

• **Cometech, Ltd.**, Solene Beach, Calif. \$150,000 laser research contract from Atomic Energy Commission to study neutron induced power sources for spacecraft use. Program covers investigations of neutron transfer methods in high temperature boiling liquid metal systems.



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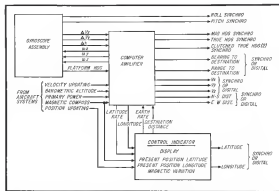
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BLOCK DIAGRAM OF AN/ASN-44 inertial navigator, under development by Litton Systems' Guidance and Control Systems Div., shows availability of outputs in either digital or analog (pushed) form to assist varying segments of future aircraft and helicopters.

Litton Developing VAX Inertial Navigator

By Barry Miller

Woodland Hills, Calif.—Litton's inertial navigator for the integrated avionics package of the new VAX business aircraft and other advanced carrier and ground-based naval aircraft and helicopters will incorporate several design features to permit high reliability, simple maintenance and low production costs.

Designated AN/ASN-44, the inertial system (AW Jan 34, p. 43) is being developed here for the Avionics Div. of Naval Air Systems by Litton Systems' Guidance and Control Systems Div. Two development models of the system are scheduled for completion late this year and its service test model are to be delivered to the Navy starting in February, 1983.

Inertial system is known to be functionally comparable to the inertial unit and the computer is producing for the Lockheed F-104 program (AW Jan 9, 1981, p. 31). That system, the LN-3, also locate a fighter's position within a mean circular error of 1.5 nm (mi) for each hour of flight.

Better Reliability

Like the LN-3, the new ASN-44 will satisfy aircraft navigation and attitude stabilization requirements.

The ASN-44 is an attempt to better the mean time-between failure (MTBF) performance of the LN-3 system in the

F-104 by at least a factor of three, according to Col Arthur C. Lowell, USMC, chief of Test/Weapon Systems Div. The highest MTBF known to be credited to the LN-3 inertial system is an F-104 firing out of a USFAP base is about 100 hr.

By using a combination of newer entry concepts and design techniques, such as mounting some of the disc drives originally on the gimbals of the stable platform, Litton and the Navy expect an inertial system with the following general properties to result:

- System operating life—over 10,000 hr.

- Weight—37.9 lb., compared with 70.3 lb. for the F-104 system.
- Size—2.44 cu. ft. (750 cu. in.), compared with 1.1 cu. ft. for F-104 system.
- Power consumption—Approximately 105 w., 22% of the F-104 inertial system requirement.

Adopting the ASN-44's for the integrated VAX avionics system (AW Apr. 1, p. 58), for which an industry contract is in progress, the Navy is requiring that Litton make available to each potential buyer on a nonexclusive basis details of the inertial system currently in preparing proposals for the complete avionics package.

Stabilized Platform

Heart of the ASN-44 will be a stabilized platform—a framework, integrated mechanism using a pair of bi-directional, gas-lubricated bearing gyros and three autointegrating, torque-balanced accelerometers. An amplifier, amplifier and controller indicator round out the system.

Outputs from the system will be in analog or digital form, as well as the outputs from the inertial platform. The computer amplifier will be a hybrid



CIRCUIT CARD for ASN-44 inertial navigator (topograph) is combined with functionally equivalent circuit board of LN-3 system and is Equipped Lockheed F-104. For personnel ASN-44 and contains three "Test Instruments" components (peripherals), then the system and operation and individual checks.

analog-digital machine. This will give it the complete inertial system self-test flexibility for adaptation to a variety of future naval aircraft requirements and permit convenient use of digital instrument knowledge of digital instrument techniques.

Inertial Platform

Inertial platform is a successor to the F-104 platform and similar in size and weight to the platform incorporated in the avionics vehicle data system. Litton is building for the Air Force (AW Aug 28, 1980, p. 48) under Project Hydrus (AW Apr. 1, p. 51). Its current function include:

- Microelectronic elements on gimbals—Microelectronic mounted directly on the platform gimbals will make possible a completely self-contained platform. This approach is expected to simplify installation and maintenance. Currently on the gimbals will integrate accelerometer outputs and convert these signals into velocity components in digital form. Signal-to-noise ratio will be increased as a result of shortened leads made possible by mounting elements on the gimbals. Reliability is expected to improve as the approach with the reduction in dip rings, simplified circuits resulting in a controlled environment should also enhance reliability. Another important consequence of the use of microelectronics will be reduction in size and weight. The platform will weigh 16.8 lb., occupy 190 cu. in. and require 25 w. Its only outputs are gyroscopic rates from the computer amplifier.

• Thermoelectric cooling—Thermoelectric, or Peltier, heating/cooling, in which current passing through junctions of dissimilar semiconductor materials causes heat to be absorbed and

desire efficiently heat the platform, will be employed. System temperature will be held in a ground environment of 120°F with no need for a coolant as cooling is taken up.

- Gyro—the at-grade mapping, gas-lubricated spin bearings and a ring actually centered that any excesses to stability and provide high repeatability and low drift. The gas spin bearing is located to be introduced to face the viscous element from drifts caused by oil lubricants or from effects produced by changes in the thickness of oil films. Magnetic field probe will rotate the bearing, not expand it, thereby, as in the microelectronic suspended gyro concept.
- Accelerometers—Four sets of the platform's accelerometers are horizontally oriented about the most of the external platform mass naturally in 90°-wide and 90°-wide long, respectively. Col Lowell said. His division is pioneering the application of microelectronics in inertial systems (AW July 9, p. 40).

Semiconductor Use

Semiconductor microcircuits (probably in the rectangular package either 4-in. square or 1-in. by 1-in.) will be used extensively throughout the system to satisfy a minimum of 80% of the system circuit requirements. Col Lowell said. His division is pioneering the application of microelectronics in inertial systems (AW July 9, p. 40).

Microcircuits will be mounted on so-called 10-in. by 1-in. carrier cards, or modules, which will be on the gimbals and the platform case to reduce maintenance problems. They will be supplemented, for example, where pneumatic parts may be necessary in design. Other passive components and discrete microelectronic components.

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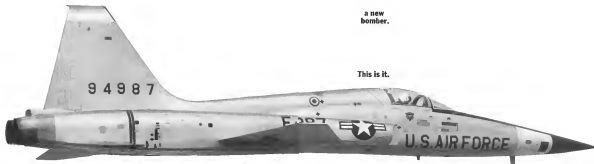
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It is the plane selected by the U.S. Department of Defense for deployment to our allies in the Military Assistance Program.

There are some good reasons why the F-5 was chosen.

For one thing, it can do many different jobs. It can operate as an air-to-air fighter, a close support weapon, an attack fighter/bomber, or a reconnaissance aircraft.

It can carry 6,500 pounds of payload. Bombs, missiles, napalm, rockets, or extra fuel. Yet the F-5

weighs only 8,100 pounds itself, unfueled.

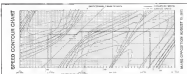
There are a number of other reasons why the F-5 was chosen for the Military Assistance Program. Speed. Outstanding climbing ability. Range.

But perhaps one of the most important reasons is the F-5's practicality. In operational squadrons, it

will require considerably less man-hours of aircraft maintenance per flight hour than other supersonic fighters. And it will operate from the sod fields and unimproved runways of forward area bases—the first supersonic fighter designed to do this.

The F-5 will do many jobs. And do them well.

NORTHROP F-5



At Lockheed Missiles & Space Company, a dedicated team of scientists devises its entire attention to problems in interplanetary navigation. Of particular interest are problems attendant to the guidance of a manned vehicle to another planet. With many successful accomplishments to their credit (such as the Polaris and various Agena missions), this group faces every new challenge with confidence.

A guiding mission for manned spacecraft guidance involves taking selected planetary optical sightings, feeding that information into an onboard computer, and computing the spacecraft's position and velocity to predict its future course. The computer will then calculate the predicted destination planet, error, decide if a correction is necessary, and

compute its value. These procedures would be repeated continuously until the planet is reached. The optimum timing and magnitude of correction, in view of the information obtained from the observations, is the subject of continuing study.

Even before work on hardware for an interplanetary mission is begun, orbit characteristics must be determined to set the requirements to be laid out to the spacecraft. An optimum trajectory must be shaped for the specific mission, in order to realize ultimate effectiveness. An outstanding accomplishment by Lockheed scientists is the completion of some 500,000 different orbits to Mars and a smaller number to Venus. Each orbit varies as to speed, fuel, departure, arrival, and elapsed time.

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type is shown in an accompanying photo (see p. 77) is at least of an equivalent function circuit from the LN-1 system. The ASN-46 development version is a lightweight, operational amplifier and contains semiconductor resistors, capacitors, discrete high-impedance, precision resistors, diodes and capacitors. The microelements, made by Texas Instruments, contain the equivalent of 25 discrete components.

Ultimately, Lathen hopes that this entire module, including discrete components, will be entirely in monolithic form.

Not all instrument supplies for the program have been selected according to Lathen and parts are being purchased and placed in sufficient quantity on life list to permit meaningful reliability statistics.

Texas Instruments probably will supply scaling circuits with Fairchild Monitors or Signetics providing backup Texas Instruments also is in line for the digital circuit.

One of the emphases in the VAK program is to standardize on a few parts, or subassemblies, to minimize the number of different parts in the various avionics sections in the VAK system.

Lathen, for example, in the computer amplifier section of the ASN-46, is trying to reduce the number of basic active circuits to five, comprising a mixture of digital and analog circuits—flip-flops, power switching diodes, demodulators, power amplifiers, high-gain operational amplifier and a lock-gain zeroing operational amplifier. While the current requirements of such units, different forms of equipment in a program may compromise and a radar will vary considerably, there will be a degree of uniformity among requirements through out the system. Col. Lathen said.

Computer amplifier of the ASN-46 will house a computer, integrator, the heading servo and precision power up-



CONSTRUCTOR INDICATOR of ASN-46 provides longitude and latitude readings and digital location in computer heading. The ASN-46 development module are scheduled for completion this year. System is planned for mission package of the VAK aircraft.

Remember the Vultee Model 72?

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plus many other modern aircraft, rockets, and missiles "The art of progress is to preserve order amid change, and to preserve change amid order."

—ALFRED NORTH WHITEHEAD

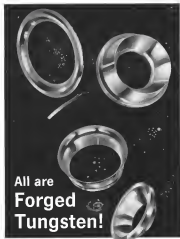
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Plastic Laser

Plastic laser which produces coherent pulses of far-infrared as well as visible light in wavelength of 6.336 microns, the highest visible wavelength yet reported for lasers, has been developed by RCA Laboratories. Plastic laser uses a polymerized surface acoustic wave with solid solution of fluorine chloride. Laser is pumped from silicon rectifier source at 3,400 Angstroms, and modulated by liquid solution temperature. Development opens the way to new family of lasers which radiate over the spectrum, a variety of shapes ranging from flat sheets to thin films, complex shapes.

gly substrates, each of which will contain microcircuits. The microprocessor computer subsystem components. The leading wire provides a trace leading directly from the platform through cracks and an externally damped inductive coupling by adding the trace leading to computer magnetic variation. The computer also magnetic constant loading and other data externally from the micro's other systems.

In the system's slot and magnetic alignment modes, the computer amplifier subsystem provides accurate alignment calibration to the platform. A range and bearing computer internally allows for great circle navigation to selected or preset destinations.

At sea, alignment of the inertial system will be possible in less than 5 min., compared with present seven days. Overall time in excess of 15 min., according to Littow engineers. In all, there are several alignment modes—including normal, rapid, coast, star and in-flight modes.

System is aligned with respect to local vertical and then oriented to true north as course and true phase steps, the first true for each of the six alignment modes.

In course alignment, Littow explains, platform gimbals are aligned to the aircraft or to an external reference as given or brought up to speed. Then, with the gyro in control of the plat-

form, the acceleration will level the platform and orient it to true north. In the normal mode, an earth alignment is achieved by gyrocompassing, in which the platform is oriented with respect to external or stored reference information.

For sea alignment, Littow plans to use a transfer alignment method in which a hand-carried master reference platform provides continuous, accurate source of heading acceleration, slant and position information. The two platforms are electromechanically and physically mated through an access hatch in the surface.

The master reference is similar to the airborne platform. It's weight is approximately 17 lb.

Enter AN/ASB-66 system is being designed for a storage life in excess of five years at operating temperature range of -54 to 70°C and an ability to withstand a vibration magnitude as high as 70g.

Laser Developments Reported at Meeting

New advances in lasers reported during the recent symposium on optical lasers in New York sponsored by the Polyscience Institute of Brooklyn with sponsorship by Air Force Office of Scientific Research Office of Naval Research and Army Research Office include the following:

• **Blue Fluorescence Observed**—Red light outside of a rubi laser impinging on crystals of divalent transition in lanthanum chloride and neodymium neodymium chloride crystals in laser-activated neodymium chloride fluorescence has produced fluorescence in the blue portion of the spectrum. Nicholas Sogah of the Canadian National Research Council reported. Such fluorescence in which high-energy light photons are converted by ions or dyes or pigments has not previously been observed and it now represents a new mechanism of generation. Although the coherence of the blue radiation has not yet been determined, Sogah said that involved neodymium in lanthanum bromide and chloride crystals at 100K temperature produce crystal lines in the 6.11 to 1.1 micron region. Wavelength of the emission increases with the square of cooling from 100K and decreases with temperature with no emission at 7°K.

• **Laser Cores Road Change**—While the heating effects of a laser beam on biological tissue has long been known, recent experiments by Kellerman Institute were Cap showed that the laser produces a microsecond electric field which can produce electrochemical changes in blood. Kellerman's Victor T. Tschering reported. The new effect might be used to halt bleeding during brain surgery, Tschering speculated.

• **Magnetic Laser Tuning Reported**—New technique which uses magnetism to tune and modulate a laser or to pulse it at extremely high repetition rates was described by Dr. Zoltan J. Kiss of RCA Laboratories. Using a silicon fluoride crystal containing traces of dysprosium which radiates continuously at 3.34 microns, RCA is able to tune the emitted beam over a frequency range of 190 g/cycle. Using another magnetic field exerted from a variable source, the laser can be pulsed at a rate of 100 kc with a pulse rate time of 300 nanoseconds. It is possible to utilize the new RCA technique either for amplitude or frequency modulation of the emitted beam.

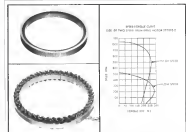
• **Ultrasonic Shutter/Modulator**—Use of ultrasonic in modulating laser beams or to serve as shutter to generate rapid pulses of extremely large magnitude and short duration was reported by A. J. DeMars, United Aircraft Research Laboratories. Technique uses ultrasonic crystal within the laser cavity. Pulse length can be varied by varying the frequency of the ultrasonic. Interaction of the light and ultrasonic waves can produce either reflection or deflection effects depending upon whether laser beam is at a right angle or other than 90° to the ultrasonic wave. United Aircraft tests were conducted using a laser which is fully tunable according to wavelength or frequency.

the index of its spouting medium, suggesting that the new technique can be applied to a variety of other laser materials. DeMars indicated.



Gallium-Arsenide Diode

Gallium-arsenide diode emits infrared radiation in dopant-free junction (E) at 0.94 microns with 0.14 micron bandwidth. Diode is mounted in conventional glass package (A). Diodes can be pulsed with currents as high as 12 amp at room temperature in 300 msec at 77K. Manufacturers: General Electric, Santa Barbara, Calif.



What! An AC 400 cps motor with 100 hp or 400 rpm? Yes. That low slip dual speed induction motor provides torque of 100 ft-lb at either 400 or 100 rpm. And as precise design eliminates Wright engineering and manufacturing capability. Note features rugged square-shaft construction with 28 poles within the 30 000-c/30 stator. Maintenance free. No gear. No brake. No radio interference. Wright Division of Avco, Andover, Andover, North Carolina. Ask for Wright Motor Data 621.

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BELL 204B TURBINE-POWERED COMMERCIAL HELICOPTER has 45-hp. disc rotor and is powered by a Lycoming LTC119-2 engine.

Aviation Week Pilot Report:

Bell 204B Offers Stability and Quietness

By David A. Brown

Fe. Worth—Commercial life extending 20 years is expected for the Bell 204B turbine-powered helicopter, civilian version of the military UH-1H Hoque, which recently received Federal Aviation Agency certification (AW Apr. 15, p. 70). First deliveries are being made this month.

Helicopter, flown here recently by the Aviation Week & Space Tech. service pilot, displayed excellent inherent stability which permitted hands-off flight over relatively long distances, responsive controls, a surplus of engine power and a proven rotor system which holds vibration and noise to a minimum.

In addition, the 204B has extended, 45-hp. long rotor blades (over 44-ft blades on the UH-1H) and 118 lb. inertia weights as such blade tip to improve inherently intermediate and lower class aerodynamics, in addition to climb, load and speed capabilities (see box, p. 84). Blade chord has been increased from 1.5 in. to 2.5 in. on the UH-1A military model.

Engine is the Lycoming LTC119-2 shaft turbine, civil version of the T53 L-9 FAA designation in the T530RA. Engine has a three turbine stage of 1,110 shp at sea level and a continuous rating of 900 shp.

Bell forecasts that in the next five years commercial sales of the 204B, including foreign military sales, will total about 200, with 80 of those going to domestic commercial or non-military governmental users, 50 to foreign governmental buyers and about 110 to foreign military purchases.

In 10 years, a total of 450-500 sales are forecast, plus sales of foreign production houses, Agusta in Italy and Mess in Japan. Agusta's sales projection is 50 helicopters per year for the next 10 years. Of this total, approximately 141 orders currently are on hand and 48 helicopters have been delivered. Mess expects sales of 25 helicopters a year for 10 years.

Bell sales forecasts for the machine are based mainly on a feeling that turbine power will gradually cause to displace the piston engine field. When that, the company believes, might be accelerated if a low cost, civil version of the created Army light observation helicopter (LOH) with cheap turbine power enters the market.

As things stand now, however, the 204B is Bell's turbine-powered market entry and the company expects the machine's performance to enable it to capture a maximum of 50% of the

civil market for its size and performance class in the years immediately ahead. Performance demonstrated during the flight here included:

- **High speeds and rate of climb.** Helicopter climbed at 3,000 fpm with maximum engine power and exceeded its design speed of 120 kt without using all available power.

- **Excellent inherent stability.** For convenience during the 204B can be set up to hold a course and has little tendency to wander. Helicopter will hold heading, altitude and speed with pilot's hands and feet off the controls.

- **Maneuvering ease and vibration.** The 204B is well suited for either air carrier or corporate personal transport work, due to its almost complete absence of vibration compared with accompanying engine helicopters and a noise level which permits conversation in the cabin.

Flight was made from Bell's Fe. Worth factory in aircraft N 71910. Gross takeoff weight was approximately 6,580 lb., of which 900 lb. was not attributable to engine and 1,800 lb. load weights, located in the rear of the cabin. Maximum gross weight is 8,500 lb. Wind was calm and the outside air temperature was 80°.

Albert Avault, Bell's experimental pilot, pointed out cockpit layout and demonstrated the engine start sequence. Basic control arrangement differs little from the military version, UH-1A

(AW Dec. 8, 1975, p. 70) and UH-1B, although the instrument panel has been changed to eliminate some military gear.

Main flight instruments and controls are installed in front of each pilot seat. Seats are adjustable fore and aft and vertically. Panel includes rotor/propeller tachometer, engine tachometer, vertical speed indicator, altimeter, dual engine fuel pressure indicators (RMI), gyro horizon, turn and bank, and engine torque indicator grouped in front of each seat. Pilot also has exhaust temperature and gas producer speed indication on his panel as well as a magnetic compass, ILS indicator and clock. Pilot sits on the traditional right side in the 204B in contrast to many Bell models which place him on the left.

Engine instruments are centered on the panel and radio gear, engine switches and hydraulic controls are on the center console between the two pilot seats.

Right side collective has engine governor and engine idle detent release. Warning light strips are on the center panel. Circuit breaker are on the overhead panel, along with some electrical switches, heating and lighting controls and the cargo sling release.

Start procedure is simple and consists of checking control location on the overhead panel, setting fuel valves and engaging the starter.

Test grip handle on the collective control can be rotated all the way to the idle/cut-off position, but a detent prevents the throttle from being pushed forward without first flight idle or 80% of engine power while in flight.

During the start procedure, the test grip is rotated to the detent, but not through it, so that if an emergency shutdown is necessary, the throttle can be rapidly returned to the idling off position to shut down the engine.

Starter is a trigger-type mechanism located on the pilot's right side. Pressing fuel valve on the center console is timed on and the starter squawks. When the gas producer reaches 30% rpm, the gas producer switch is turned off to prevent engine overhauling and the starter is released when the gas producer reaches 55% rpm.

No rotor brake was installed on N 71910, the dual 204B prototype, so that the blades begin to revolve as soon as the engine starts up to speed. Rotor brake will be standard on production models.

No engine warmup is necessary, and the helicopter was ready for flight as soon as the rotor reached operating speed. Rotor speed stage is 204 to 170 rpm, and the engine is operating at 6,000 rpm at 100% of power, or 6,600 rpm at 91% power, the maximum permissible for flight.

Torque motor is installed at 48 psi.



BELL 204B CRUISES at 300 kt. and has a top speed of 120 kt.



CABIN CAN CARRY 31 people in parallel 140 cu. ft. of cargo space. Seats Bell 204B, below, built in Italy, is shown in Norway in working with engine covers removed.



the 204R maintained its entry altitude of 700 ft. all through the test. Entry speed of 95 kt dropped slightly, but this could have been generated by the reduction of main power.

Rotor noise was noticeable in the cabin only occasionally when entering turns.

Whether was neither noticeable nor particularly disconcerting at any time, although it did increase when the helicopter approached the upper end of its speed range.

Speed Run

Speed run was made at approximately 1,500 ft. and maximum permissible indicated air speed (IAS) of 120 kt was reached after about 30-35 sec speed buildup from an 80-kt cruise. Some increase in noise, engine transmission vibration levels remained comfortable, and good response was noted through out the entire speed range.

Rated speed was 70 kts, slightly below the best rotor speed for vibration damping. N 77041 had only standard auxiliary instrumentation. Extra sound work will be done as production version.

Torque meter indicated 37-55 psi or about 570-650 hp engine output during the speed run. Turn and bank indicators had no noticeable acceleration by applying rudder, and the 204R held its speed and remained stable.

With the engine power available, it is possible to fly the helicopter up to 110 kt without difficulty, although re-

luctance increase rapidly with the higher speeds, and Bell does not recommend the maneuver.

Normal landing approaches were flown for both right and left patterns and the 204R had solid and responsive controls all the way through the approach. Visibility is not as good as that from bubble-concept helicopters, particularly in turns since from the pilot's seat, but it compared favorably with visibility from bubble-wing aircraft of about the same size.

Landings could be made to a spot within 50 ft. using an approach speed of 15-30 kt, because of the helicopter's stability. Flare point be made at a slightly higher altitude than with most conventional helicopters of the same class because of the 204R's longer tail boom.

Booms was increased in length 2 ft. to a total of 26 ft. 5 in. to accommodate the longer rotor blades.

Acceleration Delay

Also, pilots accustomed to operating nonreciprocating-engine helicopters will have to adjust to the inert of the gas producer action of the engine in the 204R to handle up speed before slight power increase can respond.

Method is to make the collective control up slowly during the latter phase of an approach so that the gas producer will have time to increase its speed. Acceleration delay of up to 4-5 sec. can generally be anticipated from a slight side position. This delay is less during full power operations and increases

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The page opposite describes one of the many Dalmo Victor achievements. Scientists and engineers of unusual skill are needed in various fields and other Dalmo Victor projects. If you would like to work with Dalmo Victor, we would like to hear from you. Write to: Dalmo Victor, Inc., 10000 S. Main Street, Suite 100, San Francisco, California 94104. We will get back to you as soon as possible.

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Larger Rotor Boosts YUH-1D Performance

The West-Spacetech performance gain using a large two-standard main rotor has been noted in the course of U.S. Army tests with the new Bell YUH-1D Apache helicopter.

In the course of the tests, evaluation was made of the YUH-1D fitted with its standard 44-ft. dia. main rotor and also with a 48-ft. dia. rotor from a Bell gunship model 204R.

Tests were made in both configurations under high-altitude, high-temperature conditions at Ft. Carson, near Colorado Springs, and at lower elevations and temperatures at the manufacturer's test facility here.

Data comparison showed that the YUH-1D with the 48-ft. dia. main rotor outperformed:

- Thrust-to-weight ratio increases of 30% at weights from 5,500 lb. to 6,000 lb.
- Radius of turn decreases at 180 kt. at 75% at 5,500 lb. gross weight, 19% at 7,000 lb., and 56% at 8,000 lb.
- Service ceiling goes of 2,000 ft. at 6,000 lb., 27% at 7,000 lb., and 49% at 8,000 lb.
- Hovering ceiling, and ground effect, matched day, increases of 34% at 5,500 lb., 38% at 7,000 lb., and 100% at 8,000 lb.
- Hovering ceiling, out-of-ground effect, 95% day, goes of 30% at 6,000 lb., and 90% at 7,000 lb.
- Maximum speed increases, at 8,000 lb. on a standard day, of 10% at 7,000 lb., and 30% at 8,000 lb.
- Fuel flow was reduced, at 90 kt. true speed, 5,000 ft., matched day by 31% at 5,500 lb. gross weight, and at the same gross weight at 6,000 ft., by 19%.
- Maximum rate of climb at 8,000 ft. is increased 8% at sea level, 15% at 6,000 ft., 50% at 8,000 ft.
- Vertical rate of climb, at 8,000 ft. at sea level, is increased 30%.



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studying optimum turbine engines for a highly mobile Military Compact Reactor it is developing for the Atomic Energy Commission.

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An exact statistical analysis

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³variable valves and connections. Pump is driven by the transmission, to ensure operation in the event of engine failure.

Boost cylinders are connected to the mechanical linkage of the flight controls. Pressure in the closed-type system normally is 400 to 1,100 psi, and a red warning light on the panel indicates low pressure. Irreversible valves prevent reverse feedback forces in the event of a system malfunction.

The 204B has not been certified with auxiliary tanks, although several developed for the military are available. Normal fuel capacity is 165 gal of JP-4, but addition of another 40-gal tank is standard equipment as shown.

Range at maximum gross weight with 165 gal fuel is about 108 mi with no stores. At 8,000 lb gross weight, range is 265 mi with no stores.

Features designed into the 2046 as a military aircraft should prove beneficial to commercial operators in maintenance time and costs. Ames wanted a helicopter which could perform its missions under all possible mission/mission conditions with a minimum of maintenance personnel, space and cost.

For this reason, the conventional 2048

- **Portable maintenance hoist** capable of cradling the engine or pulso component. Stand is of tripod design and held in place by quick-deconnect pins on the work dock. It can be broken down and transported by air.

• **Standard lubricating oil** is all you need, the most recent tech available and the engine. Oil is SAE 75W90, a synthetic lubricant developed for the military, but available on the commercial market. Oil right before oil gages are incorporated in all components which use oil in a lubricant. Engine has a flat sump and has been operated in much as 70 in. without needing additional oil.

• **Minimum of lubricants** Only two types of grease are used—one for applications on grease gun, the other a long-patched type for use in the main and rear axle drive shaft assemblies.

- **Hydrochagrabidae** water blades (incl. rice tail water blades)
- **Flagell.** non-structural stems does which have joint opening (nodes) and bearing leaves from central components
- **Monocots** of special tools, only 6 of which are needed for field maintenance

Junior blade life requested for construction is 1,900 hr., but Bell is confident blade life can go up to 3,000 hr.

Military maintenance experience indicates that slightly more than 1 hr of maintenance is needed for each hour of flight. Of this, two thirds is regular scheduled maintenance and one third is field maintenance. Jeff hopes to reduce

AVIATION WEEK & SPACE TECHNOLOGY

due to a 11 min of flight to maintain
these for commercial use.

Projections of commercial sales over the next five years indicate that Bell expects the 204B to make a significant market penetration in five areas—air carrier operations, nonair carrier governmental use, commercial operations for public sector and across markets, including business satellites.

Ball studies show there is a market for the 2048 with both scheduled and non-scheduled air carriers. Although the former probably will be the largest por-

Success of San Francisco & United Helicopter Airlines as a nonsubsidized carrier has heightened interest among prospective operators in the possibility of successful helicopter operations in other metropolitan areas. Bell Helicopter Company finances a helicopter airline in five major metropolitan areas within six years.

Andrew Aerial, 2048 sales specialist, believes Bell will capture up to 10% of the 50-helicopter market he focuses developing in the air transport industry in the coming five years.

Government agencies—forestry agencies, police, TVA and NASA—will purchase a minimum of 20 304Bs in the next five years, the company believes. Although Bell does not expect the 304B

to replace the widely used Bell Model 47, trawler Model 47 operators will get a 30% discount during sales promotion tour which will begin in May.

Sales to commercial operators will be based largely on the productivity of the helicopter. Aerial foot, and by inference the 204R's construction capacity, speed and lower costs (about \$10 per hour now costing upwards of \$20) will make a market for at least 10 in the next few years.

By mid-1990, as the air takes on a more concerned, probably, will come to the corporate market. Bell expects the 204B to be the first helicopter capable of competing effectively with fixed-wing business aircraft. Nonpassenger capacity plays into Bell's case for short distances should give it the competitive advantage. And the 204B now opens the door to company sales that previously had been closed to rotary-wing aircraft, he said, and he expects a market for 30 of the helicopters to develop in the next five years.

Foreign sales are less accurately predictable due to political and business uncertainty in some nations, but Bell expects to sell about 140-200 lbs. abroad, exclusive of foreign licensed production. Political and financial changes could alter this estimate.

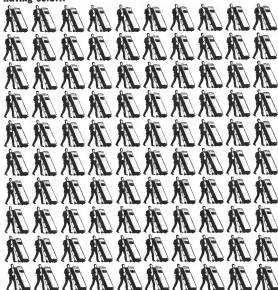
U.S. Business & Utility Plane Shipments

October 1982

[illegible]

Note: This listing is for shipments from the publisher to retail outlets through October 31. A total of \$1,000,000 of additional merchandise will be available in November.

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...TRW-130 Digital Computers, we're reducing the price \$10K

The TRW-130 (AN/UYR-1) was a good buy at the old price: advanced, high performance hardware; 8K words of core storage; NTDS compatibility; flexible interrupt system; powerful "stored logic" design—for work under the cost of computer machines.

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Over \$2 million in programming efforts have been expended by TRW and the many TRW DCUs are assisting in a large and rapidly growing program library. TRW-130/AN/UYR-1 will be available this summer. We've taught hundreds of users how to program and maintain

their systems. Field reports from military users have demonstrated a reliability of 900 hours Mean Time Between Failures.

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PAC Receives Certification for Tradewind

By C. M. Pittman

Bethel, Calif.—Conversion of the Twin Beech's dual 6a and rudder into a single, swept, vertical tail plus addition of fuselage leading gear gives a complete, new-looking appearance to the aircraft. These two modifications are the most noticeable of several, which Pacific Aerospace Corp. has incorporated into a new Twin Beech configuration, called the Tradewind.

PAC, attempting to market a complete aircraft rather than modifications, swept, curved planes, has obtained a single, swept, vertical tail configuration from Federal Aviation Agency, covering five different modifications. Four of the five modifications have been developed by the company, and include higher gross weight, wing-mounted windshield, picture windows, and single tail conversion kit. PAC is developing the other conversion package—the Veegee (Velocity Aerobics and Progress Tools) turbine gear kit.

Company will readily, prearrange aircraft to Tradewind configuration,

but their primary interest is in selling Tradewinds, tailored to customer requirements with various optional equipment.

Major modifications that were performed on the Twin Beech to convert it to Tradewind configuration include the following:

• **Single tail modification kit.** Package includes replacing double tail of the Twin Beech with a single, 6a and rudder. This conversion vertical fin and rudder area from 20.1 to 25.7 sq ft, and 11.5 to 17.7 sq ft, respectively. Additional vertical tail area provides better lateral stability and handling characteristics and swept fin reduces drag. Elevator surface area also is increased from 22.0 to 35.4 sq ft when sectors needed for function of movement of dual and dual are eliminated.

• **Gross weight conversion kit.** Boosting the aircraft's maximum gross weight to 16,200 lb (13,700 lb for Twin Beech), the kit allows each engine to develop full rated METO power of 190 hp. Formerly, Twin Beech was limited to 160 hp per each engine be-

cause of cooling problems. To more effectively cool the engines, jet exhaust stacks, a new core air scoop and oil-fueler cowling are added. Cowling package also provides for an increase in angle of incidence of horizontal stabilizer from -2.5 to -5.5 deg. to improve longitudinal stability and handling characteristics, and combination of new wing tips to reduce top climb speed.

• **Velocity turbine gear kit.** Many aircraft have a clutch mechanism in replaced with a turbine gear. Velocity is raised by loading and deflection of power since no more wheel steering provisions are incorporated. Modification package also includes modification of a new, streamlined nose with glass lines. The new nose section, 15 in. longer than that of the Twin Beech, houses optional radar equipment (RCA AVQ-45 or Collins WP-101) and radio gear.

• **Picture windows kit.** Passenger visibility is increased by addition of two 13.4 x 40-in. picture windows, one on each side of the cabin. The cabin 13.4 x 19-in. windows on each side of the picture windows also are larger than the



NEWLY CERTIFICATED Tradewind features single vertical fin which gives the airplane an overall length of 110 ft. 5 in. The aircraft has been certified for maximum take-off weight of 16,200 lb. The aircraft will cruise at 110 mph at 70% power at 10,000 ft. It is powered by two P&W R980 engines with Hamilton Standard two-bladed propellers. Aircraft is fitted with a turbine landing gear.

INCREASED ANGLE of incidence of the horizontal stabilizer permits the Tradewind to be trimmed out properly for most efficient operation according to Pacific Aerospace Corp. Airplane has easy between 70 passengers and has a maximum weight of 2,100 lbs. with full tank options. The plane sells for a base price of \$97,000. Aircraft's empty weight load is about 3,500 lb.



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Several years ago, we formed the nucleus of our Space & Armament Systems Group. Its assignment: to originate ideas for new missions, define their feasibility and determine how to accomplish them.

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Our Space & Armament Systems Group has proven so valuable on vital projects such as Apollo Command & Service Modules that we believe it is one of the most important keys to our future growth.

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You'll have to be honest, too. Big enough to shoulder some of the blame when little things go wrong. Big enough to pass along some of the credit for success.

On the other hand, we expect you to take some time to get your feet on the ground. We'd be delighted, of course, if you could come up with some brilliant ideas your first week or so. But we admit that this would be asking quite a bit.

You'll have to enjoy variety. Some engineers like the change of pace, but others

why, you'd be unhappy from your first day on. In this exclusive group variety isn't the exception... it's the rule!

You'll have to earn your own way. As you might suspect our starting salary for such specialized work is quite liberal. But from that on, it's up to you. We pay on merit only. You set the rate at which you advance. This applies to promotions, too. We'll move you ahead as fast as you can handle the work. Frankly, this is as much to our advantage as yours. As far as fringe benefits are concerned, we have retirement insurance stock purchase plans... and all the rest.

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What we would like from you... now. We've briefly covered a few of the advantages (and what some may consider disadvantages) of joining our Space & Armament Systems Group. If you meet the requirements at right and want to learn more, we'd appreciate hearing from you immediately.

There's no need to send a detailed resume, however, just attach a brief list of your qualifications along with a rough idea of your salary requirements to:

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Honeywell Aerospace Division
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TECHNOLOGY

Staff Engineer, Electronics—(MR) Eng 1, 5 years' experience in electronic systems including communications, telemetry, tracking operations, radar, instrumentation. Responsible for analysis, design, testing, and data.

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Tradewind's cockpit interior, above, shows four of the five seats in the cabin. Five six- or seven-passenger seating may be chosen by customer to suit his particular requirements. Below, three views of aircraft show its dimensions.



standard 34 x 20 windows of the Twin Beech.

• **Windshield modifications.** New two-piece, wrap-around windshield shows inside of wind shield, except when the two sections part, providing unobstructed forward and side visibility.

Five Beech aircraft, which PWC will convert to Tradewinds include G and H models of the C-45, SNB-1, and D-118.

Also conversion, the price of the basic Tradewind is \$97,000. Two methods of modifications performed, with or without conversion to the software, engine, propeller and accessories and

a single panel of flight instruments. No radio equipment is installed at this price, but the customer has a choice of a five- or six-passenger interior floor plan.

Optional items include a 4-hr. 6-cyl. engine, fuel for 50,000 and three radio packages, ranging from \$24,565 to \$31,500. Fuel capacity may be raised to meet customer's requirements in installation of two 50- or 100-gal. wing tanks instead of mainline. This would supplement the basic Tradewind's 202-gal. capacity stored in four internal tanks.

A total of 400 gal. would afford a maximum range of 1,500 stat. mi.

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Financial Briefs

Yarn Industries Corp. Buffalo, N.Y., earned \$177,551 on sales of \$261 million during 1962. Comparable 1961 figures showed \$1.2 million earned on sales of \$29.1 million.

Elo Corp. reports \$17 million in sales and income of \$177,000 for 1962. Comparably 1961 figures showed sales of \$15.5 million with an income of \$184,600.

Westinghouse Electric Corp. showed a net income of \$57 million on sales of over \$1 billion for 1962. Comparably 1961 figures were \$45.4 million earned on sales of slightly over \$1 billion. Increased earnings are attributed to increased operating efficiency from cost-cutting and other programs.

Ames Electronics Corp. reports earnings of \$1.6 million on sales of \$22.8 million for the last six months of the fiscal year ended Dec. 31. Earnings for the same 1961 period were over \$1.5 million on sales of \$19.4 million.

Borg-Warner Corp. earned \$33 million on sales of nearly \$600 million for 1962. Figures are 41% and \$24.6 million respectively over 1961. For the same company period \$21.4 million was earned with \$2.87 for the previous year. Borg-Warner attributes increased earnings to benefits coming from 1960-61 investments in new plants and equipment as well as increased sales.

Guaranty Aircraft Engineering Corp. Bethesda, L.I., N.Y., earned over \$6.2 million on sales and other income totaling about \$157.4 million for 1962. Comparably figures for 1961 were \$6.1 million earned on sales and income of \$157.3 million. For these earnings were \$2.81 in 1962 and \$2.76 the year before.

Ampco-Borg Electronics Corp. and subsidiaries report 1962 sales of \$9.3 million with earnings of \$2.3 million equal to \$1.69 per share. Sales for 1961 totaled \$7.3 million with earnings of \$623,299—or 45 cents per share. For the previous 1962 earnings were \$772,134 on sales of over \$7.1 million compared with a net loss of \$268,874 on sales of \$20 million for fourth quarter 1961.

Sperry Rand Corp. had sales of \$590.6 million and earnings of over \$16 million for the nine months ended Dec. 31. Figures for the same 1961 period showed sales of \$567.8 million with earnings of over \$18.2 million.

Mississippi Electronics Co. earned over \$26.8 million—\$5.72 per share—for 1962 sales of nearly \$750 million an

ording to performance reports. Honeywell's 1961 earnings totaled \$24.9 million—\$2.45 per share—on sales of about \$470.2 million. Military and space business showed the largest growth during the year and accounted for 46% of total sales in 1962.

Aerospac Corp.'s earnings for its first quarter ended Dec. 31 totaled \$28,516 on sales of \$14.2 million—compared with earnings of \$29,724 on sales of \$12.8 million for the comparable 1961 quarter.

Kaiser Steel Corp. had a net loss of \$12.9 million—\$2.52 per share—on sales of \$285.5 million. Comparably 1961 figures show an income of \$17.5 million—\$4.33 per share—on sales of \$235.9 million. Loss is attributed to lower demand for steel on the western U.S. and competition from foreign imports.

United States Steel Corp. had fourth quarter 1962 earnings of \$41 million on sales of \$885.5 million. Yearly income for 1962 totaled \$163.8 million on sales of \$1.5 billion—compared with 1961 earnings of \$119.2 million on sales of over \$1.3 billion.

Leo Siegel, Inc. earned \$2.8 million on sales of \$58 million for the six months ended Dec. 31. For the same months ended the same date last year, Leo Siegel earned \$1.5 million on sales of \$51 million. There is no comparable figure for 1961 since Leo Siegel, Inc. and Siegel Corp. merged in June, 1962.

Telecomp Corp.'s production report for the year ended Dec. 31 showed earnings of \$770,325 on sales of \$43.5 million. Comparably 1961 period showed a net loss of \$6.9 million on sales of \$38 million.

National Aeronautical Corp. of Ft. Worth, Texas, and subsidiaries had sales of \$10.2 million and earnings of \$661,890 for the first year ended Nov. 30. Comparably figures for the previous year showed sales of over \$9.2 million with earnings of \$645,400.

Continental Motors Corp. sales for the fiscal year ended Oct. 31 totaled \$171.9 million with earnings of \$2.7 million—memories of 34¢ and 68¢ on the preceding year's total of \$127.8 million in sales and earnings of \$1.4 million.

Moss Screwstitch, Inc. earned \$124.8 million on sales of \$4.6 million during the second quarter ending Dec. 31. Earnings for a comparably 1961 period were \$76,935 earned on sales of \$1.9 million. Total for the six months ended Dec. 31 were \$225,311 earned on sales of \$5.5 million compared with \$186,418 earned on sales of \$1.9 million for the same 1961 period.



X-20 Power Source

X-20 (Douglas) electrohydraulic power source, a hydrogen-neutron fueled power source built by Southern American Drives, Inc., is being delivered to Boeing in Seattle. It is one of two identical units to be used aboard the orbital glider.

Harco Power Co. Inc. had 1962 earnings of \$31.2 million on sales and income of \$474.8 million—22% and 38% increases respectively over 1961.

Rado Corp. of America had 1962 sales of \$1.751 billion with operating profits of \$81.5 million equal to \$1.94 per share. Sales in 1961 totaled \$1.546 billion with operating profits of \$57.4 million—equal to \$1.91 per share.

Long-Term-Vought, Inc. earned over \$6.6 million on sales of \$337.4 million during 1962. Comparably 1961 figures showed a net loss of \$1.5 million on sales of \$182.5 million.

High Voltage Rectifying Corp. summarized its public relations, earned \$3.4 million—68 cents per share—on sales of \$17.2 million during 1962. High Voltages earned \$1.2 million—50 cents per share—on sales of \$13 million in 1961.

Halscom Electronics Corp. had 1962 earnings of \$1.3 million on sales of \$217.7 million. Earnings in 1961 totaled \$1.1 million on sales of \$189 million. For these earnings totaled 61 cents in 1962 and 55 cents in 1961.

Nelap, Inc. earned \$1.2 million on sales of nearly \$48.8 million during 1962. Earnings for 1961 totaled \$746,738 on sales of \$38.2 million. For these 1962 earnings were 48 cents compared with 34 cents for 1961.

Beece Corp. had consolidated 1962 sales of \$10.2 million with earnings of \$137,518. Comparably 1961 figures were sales of \$9.1 million and earnings of \$65,717 after a credit of \$85,630 on sale of assets which offset a net loss.

Known Aircraft Corp. had sales of \$55 million and earnings \$600,890 for 1962. Sales for 1961 totaled \$59.7 million and earnings totaled \$428,000. The gains in earnings are due to helicopter development work during the year.



MISSILES AND SPACECRAFT

Aviation is a monthly magazine of the defense industry. It is published by the Department of Defense, Office of Defense Publications, and is available to all members of the defense industry. It is published by the Department of Defense, Office of Defense Publications, and is available to all members of the defense industry.

HUMAN ENGINEERING GUIDE TO EQUIPMENT DESIGN

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Simulation

To plan digital simulation for studies related to earth orbit, translunar, interplanetary and re-entry trajectories, making simulation of rendezvous guidance and control systems.

Applied Mathematics

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cedures, perturbation theory and space mechanics.

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WHO'S WHERE

(Continued from page 10)

Honors and Elections

Leon Nardi, of the Technical Staff, Aircraft Engineering and Manufacturing Branch of the Federal Aviation Agency, has received the Italian government's Order of Merit in recognition of "services rendered to the Italian government and aircraft industry in the field of civil aviation."

Changes

John W. Anderson, general manager, Massachusetts Institute of Technology, has resigned. Dr. Robert J. Kestel, director of engineering, has resigned. Dr. Charles W. Gable, chief, Systems Division, California Institute of Technology, has resigned. Dr. Joseph H. Taylor, director of research, has resigned. Dr. John G. Smith, director of research, has resigned. Dr. James R. Fenn, senior manager, Electrical Section, has resigned.

Robert R. Newman, director of engineering, Electronic Systems and Test, has resigned. Dr. J. T. Thompson, Corp., North Hollywood, Calif.

G. W. Taylor, international sales director, American and Test, has resigned. Dr. J. T. Thompson, Corp., North Hollywood, Calif.

Charles L. Gable, chief, Systems Division, California Institute of Technology, has resigned. Dr. Joseph H. Taylor, director of research, has resigned.

William G. McHenry, general manager, has resigned. Dr. J. T. Thompson, Corp., North Hollywood, Calif.

Robert D. Kestel, director of engineering, has resigned. Dr. J. T. Thompson, Corp., North Hollywood, Calif.

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First Fiscal Quarter Summary—1963

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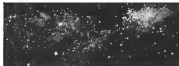




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Keywords: *depression, mood, personality, stress*

Methods: Study of 1000 patients, 1990-1992, comparing

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[illegible]

AVIATION WEEK
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LETTERS

Crash Locator Beacon

Re: FAA Plans Wide Receiver Program (AW Mar 23 p. 45)

I read this article with interest and some small degree of comprehension of the purposes and problems involved, but as my language would I wonder why along with the receiver (or why not long ago), a transmitter designed to receive crashes and to become operative in the event of a crash (not the controlled glider landing type) could not be installed to help tracking planes locate the crash and that procedure will to my opinion.

It seems that might be especially useful in the case of planes missing during over-ocean flights, when chances of other planes when search for crash and find nothing. I realize the receiver has the same purpose of helping investigators determine the cause of crashes, but this is of little help to the victims of that particular crash. A crash locator beacon could be.

I don't believe this idea has never been considered or investigated. Perhaps some reader can tell me why it was never developed.

WALLACE L. BROWN
NORTH OLE

Assault Stratagems

I am sure many suggestions are tested each day by amateur strategists as to how to improve U.S. striking power. Just for the record, how are those ideas doing in particular with improvements in air-to-air refueling arms.

• Construct concrete-paved airfields

Adoption: Work continues the application of the receiver as the latest trend in the aerospace's advanced technology. Address letters to the Editor, Aviation Week, 230 E. 42nd St., New York 36, N.Y. Try to keep letters under 300 words and give a complete address. We will not print anonymous letters, but names of writers will be withheld on request.

current type category as European nations appear to launch McDonnell F-101 nuclear weapons carriers. The aircraft would be kept underground possibly 10 to a category. They could be equipped with which and upon their return be guided to ground targets in underground facilities, or they could be launched without which then returning home carrying load in cargo, and the what could be designed to open launch and abandon the plane in a pre-determined area, probably near the category station. With the capability controlled in limited self-defense systems they can maintain shape, each position could be made less vulnerable to surprise attack, thus give us even greater self-defense.

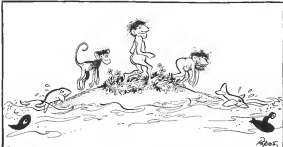
• Below light deck category for aircraft carriers. If it should prove economically feasible, it is not too far from current type category. With the light deck category, the light deck, either directly forward or asternward to the side that should make aircraft carriers less vulnerable to surprise nuclear attacks. Even with the light deck category, the aircraft could be launched from a side-on-board, and debris protected from deck. Concrete may even be vulnerable to lateral use so that launching operations

may continue even from a slowly sinking carrier. It is of course difficult to say just what the benefits are of using the present elevator plus light deck category system while under the aspect of atomic attack, but chances are elevation may give both the aircraft rising and launching operations may be expedited by internal release. Again, plans should be made of being converted for launch launchers to allow for greater range or larger loads of weapons. Although reports that the plane in that case would only try to reach their targets and then are destroyed and not the plane.

• Current old technology into launching nuclear missiles to be stored around in the Arctic sea in machines. The new targets would be destroyed and the technology changed into "old" for the Atlantic navy. The ships should be installed against those failed so that they could only be destroyed by a direct or very close hit. Anti-aircraft guns would be replaced by surface-to-air missiles on to light reconnaissance and target-finding helicopters would give protection against submarine attacks.

Our more work with regard to the wheel-less planes. It would perhaps be possible to recover such craft by developing separate self-defense systems, covering a specially sprung platform designed into a landing and launching device. The craft should be run on tracks and be able to run at up to 180 mph over a two-mile stretch track machinery could also be used to create the landing operation for the X-15 and its successor.

ROSE G. MEXIAUX
Methuen, Mass.



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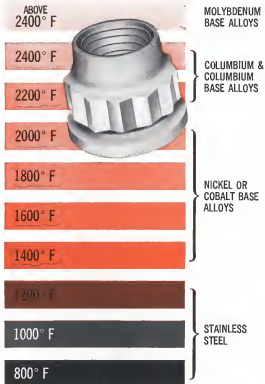
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